

Agricultural Research IN SOUTH DAKOTA

SIXTY-THIRD
Annual Station Report
JULY 1, 1949 to JUNE 30, 1950

Agricultural
EXPERIMENT STATION
South Dakota State College
Agriculture & Mechanic Arts
BROOKINGS, SOUTH DAKOTA



Letter of Transmittal

DEAN A. M. EBERLE

Division of Agriculture

South Dakota State College

DEAR DEAN EBERLE:

The sixty-third annual report of the South Dakota Agricultural Experiment Station is herewith presented for the fiscal year ending June 30, 1950. While it presents a report of progress of the Station's research activities during the year, it differs slightly from former annual reports. The first 100 pages of this report comprise the year's quarterly issues of the *South Dakota Farm and Home Research*, which were mailed to the farmers and homemakers of the state upon request. Subsequent pages set forth a brief report of the research activities which have not been discussed in the first four issues of the Quarterly.

Increased state funds made available for research by the State Legislature have enabled the Station to increase and strengthen its scientific staff, acquire needed laboratory facilities and to otherwise improve its physical plant at both the State College Station and the substations throughout the state. Through the cooperation of the Bureau of Reclamation, additional research in irrigation agriculture is carried on at the two Reclamation development farms near Huron and Redfield. This research is conducted to secure the essential facts with respect to irrigation requirements and practices prior to the building of the irrigation structures by the Bureau of Reclamation.

During the year some of the research investigations have been completed and work has been started in eight new fields. Results of the completed research have been set forth in the various publications of the Station and in seventeen scientific articles submitted to technical journals. As in previous years, Field Days have been held at both the main Station and at the substations. This year these field activities have been exceptionally well attended, and the interest shown by the farm and ranch operators of the state has been a real inspiration to the members of the Station staff, spurring them on to still greater achievements for the future.

Respectfully submitted,

A handwritten signature in dark ink, reading "C. B. Johnson". The signature is written in a cursive style with a large, flowing "J" and "S".

Director, Experiment Station

4-4-51

Agricultural Research in South Dakota

Sixty-third Annual Report

July 1, 1949, to June 30, 1950

South Dakota Agricultural Experiment Station

I. B. Johnson, *Director*



37059

SOUTH DAKOTA STATE COLLEGE
of Agriculture and Mechanic Arts

Brookings, South Dakota

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A foundation field of Norghum, an early grain sorghum.

Norghum

By C. J. FRANZKE

TAILOR-MADE for South Dakota's own climate and soil! Norghum, an early combine grain sorghum, was developed by the Agricultural Experiment Station to meet the needs of South Dakota farmers and ranchers for a stable feed supply. As its name implies, it is a sorghum for the north, and is adapted to all parts of South Dakota.

Matures Early

Norghum gets ripe before frost and can be harvested by mid-September.

Other grain sorghum varieties now grown in South Dakota have been brought up from southern states and have not been adapted to our shorter growing season. These varieties are too late in maturing and the crop is killed by frost before the grain ripens. Later maturing varieties dry out slowly and spoil easily when put into storage. Also, if the immature crop is left standing in the field to cure, the stalks break over making combining difficult. In the past, sorghum has proved

to be about as hazardous a crop to grow as corn.

Drought Resistant

Norghum fills the gap in feed grains where corn is a hazardous crop due to drought and grasshoppers. Where corn failed in South Dakota this year, nearby fields of Norghum flourished and produced excellent crops.

As a feed for livestock, it is almost equal to corn in the amount of nutritive value it supplies, 100 pounds of grain sorghum being equal to 95 pounds of corn.

Stands Up Well

Mature plants of Norghum stand longer and resist lodging better than Sooner Milo or Early Kalo. Norghum grows to a height of 36 to 46 inches. The seed cluster is long and open which allows for thorough drying of the seed and is better than other more compact types, such as Sooner Milo or Midland, which often mold. Also, the seed head grows well above the foliage, making it easier to harvest by grain combine.

Yields Are High

Yields of Norghum are considerably higher than other grain sorghums which were tested throughout the state. Tests at three locations give a 3-year average of 47.7 bushels an acre for Norghum, as compared to 26.2 for Sooner Milo, its nearest rival, and 29.2 bushels an acre for Rancher, a forage sorghum.

Result of Years of Cross-Breeding

Agronomists have been working on the development of a hardy, early ma-

turing sorghum for South Dakota since 1930. Norghum is a cross of three different sorghums, Dwarf Feterita, Dwarf Freed and Yellow Kafir. The seeds, which are medium in size and reddish brown, germinate rapidly and at a low temperature. This is very important, especially in the northern states where it may be necessary to plant early and under unfavorable growing conditions.

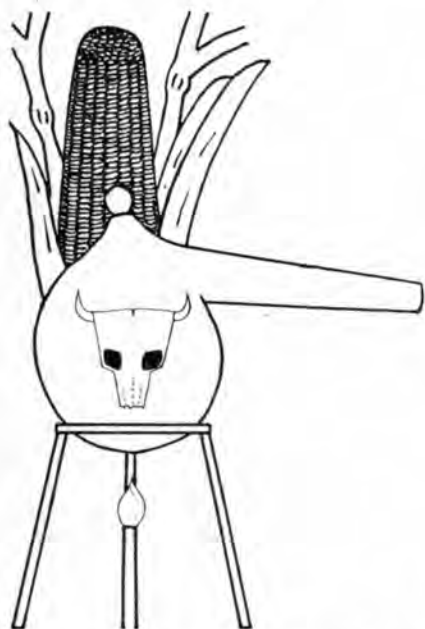
Rate of Planting

Norghum should be planted in rows at the rate of 2½ to 4 pounds of seed to an acre. The lighter rate of seeding should be made in the drier areas of South Dakota.

Norghum will produce well on all soils suited for general agriculture, but thrives best in a rich, warm sandy loam soil, well supplied with organic matter. A water logged soil will not grow a satisfactory grain crop. Heavy types of soil that warm slowly in the spring and bake easily are less satisfactory than are the lighter soil types. However, these heavy soils are usually rich and will produce a high yield of grain if properly handled. Soils that will not produce a crop of wheat seldom produce a profitable crop of sorghum grain. Norghum, like other sorghums, is more resistant to alkali soils than most other grain crops, but cannot tolerate excessive quantities.

About 1600 acres of Norghum were grown by the County Crop Improvement Associations in the spring of 1949.

Norghum is the answer to the demand for a dependable grain which will produce a crop on dry land during hot summer months. (Project 61, Agronomy Department.)



Nitrate Poisoning

By E. I. WHITEHEAD and A. L. MOXON

Losses Investigated

While investigating previous cattle losses in Sully, Potter, and Walworth counties, samples of cornstalks from 12 fields in which cattle losses had occurred were taken for analyses. About one-third of these cornstalk samples had nitrate contents high enough to have caused death losses. This does not explain the cause of the so-called "cornstalk disease," however, since cattle losses occurred in other fields having cornstalks with a low nitrate concentration.

Drought Increases Danger

A material increase in the nitrate content of cornstalks is brought about by drought damage. Samples of barren corn plants from two drought damaged fields were analyzed this year and these plants were found to contain 1.93 and 1.62 percent potassium nitrate.

Corn Grown on Alfalfa Sod

Silos filled with corn grown on alfalfa sod and damaged by the heat be-

SUDDEN DEATH may strike cattle and sheep in South Dakota this fall unless proper precautions are taken. In dry seasons such as the past summer, the nitrate content of forages from common farm crops, such as oats, barley, wheat and corn is increased and may prove to be dangerous for livestock. Cud-chewing animals feeding on these forages sometimes develop nitrate poisoning, the symptoms of which resemble those of cyanide or prussic acid poisoning.

What Happens

This is what happens. The nitrates are changed to nitrites in the first stomach of the animal. These nitrites react so closely with the hemoglobin of the blood that the blood can no longer carry oxygen to the body tissues and the animal dies.

fore it is cut for the silo may cause trouble. A silo in Yankton county, filled with drought damaged corn grown on alfalfa ground, caused considerable excitement when pungent smelling, yellowish - brown gasses came out through the cracks between the tiles. These nitrogen oxide gasses resulted from the breakdown of nitrogen compounds in the corn and caused any vegetation with which they came in contact to turn yellow. A similar condition was observed in Roberts county.

Samples from the silo in Roberts county were analyzed for nitrates. A sample taken from the top of the silo a few days after it was filled contained 6 percent nitric acid which would have been fatal to cattle if fed.

After fermentation was complete, the silage from the top of the silo was hauled out and spread on a field. Silage remaining after the top was removed was found safe and has been fed for several weeks without any bad results. The nitrates, which were released when the silage fermented, all came to the top layer of silage and thus were removed when the silo was cleaned off.

We have no record of silage causing cattle losses due to nitrate poisoning.

Poisoning from Oat Hay

During the drought years of the 1930's frequent cattle losses were reported when oat hay was fed. In the majority of these cases death losses could be traced to the high nitrate content of the hay. A concentration of 1.5 percent of nitrates as potassium nitrate in forages (dry weight basis) is considered to be about the maximum content which can be fed safely.

In field studies this year of oats and barley grown in eastern and western areas of the state it was found that several samples, particularly those from the Black Hills area, were high in nitrates. The values ranged from 0.14 to 2.20 percent potassium nitrate in oat samples collected near the eastern border of the state, and from 0.41 to 5.42 percent for oat samples from the Black Hills area.

Pigweeds Also High in Nitrates

Of all common crop plants and weeds analyzed, pigweeds contained the highest concentration of nitrates. During dry growing seasons, pigweeds may contain up to 5 or 6 percent nitrate as potassium nitrate. If hay or fodder contains appreciable quantities of pigweed, it may be dangerous to feed.

Simplest Solution

When the nitrate content is about 1.5 percent or more, the forage should be fed with caution. Since a laboratory analysis would be necessary to determine the amount of nitrate in the forage, probably the simplest and safest solution would be to mix the oats with hays of low nitrate content, such as alfalfa or prairie hays.

Analysis Done at Laboratory

Samples sent in for analysis should be representative of the feed and should weigh at least one pound. Address to Experiment Station Chemistry Department, South Dakota State College, Brookings. There is a charge of \$1 per sample for the nitrate analysis. (Project 87, 130, Station Chemistry Department.)

BREEDING BETTER *Pigs*

By J. WALTERS McCARTY

FINDING MORE RELIABLE MATING systems for pigs which hog producers can put to good advantage is the object of the swine breeding research conducted by the Agricultural Experiment Station.

Our present approach to the problem involves developing inbred lines, then crossing those lines to see how their crossbred pigs perform. Besides the inbred and crossline lots, we raise an additional lot in about the way we think most hog producers raise their pigs. We call it our check lot.

What the Records Show

In order to have something concrete on which to base our selection we're keeping records of (1) litter size at farrowing and at weaning; (2) weight of each pig at weaning; (3) individual pig weights at 154 days; (4) a type score at 225 pounds, or market weight; and (5) complete feed records to determine how well each mating group uses the feed it gets to make pork. All these figures go into a composite figure or index which is the most accurate method we know for being sure that all those performance characteristics are taken into consideration. Chances are that these records are more detailed than most of you



A four breed line cross pig.

feel it would pay you to keep. We feel, however, that a lot of improvement could be made by use of a few simple records alone.

Pigs in that check group we mentioned are all purebred Poland Chinas. We go out every year and buy a boar or two to mate with the best gilts and the best performing older sows. In eight check litters farrowed this spring there were only 5.1 pigs each, of which 3 were raised to weaning. Those 24 pigs weighed 160 pounds apiece at 5 months of age and have used 352 pounds of feed on pasture for each 100 pounds of gain.

Inbreeding a Powerful Tool

In developing two inbred Poland China lines, and one each of Duroc, Hampshire and Yorkshire, we're attempting to take advantage of the fact that inbreeding is a powerful tool in forming genetically unrelated families. At the same time, inbreeding promotes what we call segregation which means that some pigs get more than an average share of characteris-

tics for good production. And you're right in adding that by the same process some pigs get *less* than their share of good production factors. Using our records, we try to keep back for breeding those pigs which seem to have the best combination of good characteristics, and to market those having only average or less than average production.

Some experimental hog breeders—like corn breeders—have found that crossing these inbred lines produces crossbred individuals which equal and often better the performance of the parent stocks.

Combining Ability

We're testing several inbred lines in two mating groups to determine their combining ability. One of those



(Top) Inbred Poland Chinas. (Bottom) Outbred Poland Chinas. Our inbred Poland Chinas have been developed from an outbred population such as those shown above. By careful use of records with attention to economic characteristics, as described in the article, we are attempting to pull a superior inbred line from the Poland China breed.

groups involves rotational crossing of four inbred Poland China lines, while the other is a rotational cross of inbred lines from the Hampshire, Poland China, Duroc and Landrace breeds. Each fall during the mating season inbred boars from the next line in the rotation are brought in to mate with the crossbred gilts saved from the previous spring's farrow. Until this year our crossline pigs have been outperforming the check lot on every count, but this year, although there were still three pigs more per litter at farrowing and $2\frac{2}{3}$ more at weaning, the crosses averaged 3 pounds lighter at weaning and 12 pounds apiece less at 5 months of age than did the check lot pigs.

These differences in gain are still offset by the greater numbers of the crossline pigs. We have also noted that the four breed line cross gilts, with few exceptions, require just one service to be with pig.

Recommendations

Any recommendations? Yes, these general and tentative ones. If you're raising purebreds, linebreed. That is, if you can't buy better sires than you produce at home, use sons and grandsons and good females from the very best individuals in your herd. If you're producing market hogs, cross breed, using at least two and possibly three breeds, always introducing the next breed in the cycle by using good purebred boars.

Our experimental herds are located at the State Experiment Station at Brookings, at the Irrigation Field Station at Newell, and at the North Central substation at Eureka. Stop in, we'll be happy to show you around. (Project 124, Animal Husbandry Department.)



New Ideas for Farm Septic Tanks

By H. H. DE LONG and NIELS B. ANDERSON

POWER LINES, running water and septic tanks—what's the connection and what does it add up to for the farm home?

With rural electrification, it becomes possible to have automatic water systems and modern sewage disposal—and that's where the septic tank comes in. At present, the majority of rural septic tanks are of the monolithic or poured concrete type. Making such a tank requires good aggregates (sand, gravel or crushed rock) which are not always available

in small quantities. The precast concrete tank is seldom used because of the high transportation costs involved from the manufacturers to the farm. Other tanks, such as the clay tile, are generally too small for good performance, or, as in the case of the steel tank, may rust.

Two New Types of Tanks

For these reasons, new types of tanks are being tried experimentally in hopes of getting around some of the above problems. The first to be built

was a vertical cylinder type constructed of concrete silo staves. This product is available in the state and can be transported readily. The other type built was of the rectangular concrete block type. This product is even more extensively manufactured throughout the state than the concrete silo stave.

The tests now being conducted will prove the durability and ease of construction of the two new tanks. In operation, they are no different than the monolithic poured concrete tank, and the new tanks have already proved their functional equality. Neither of the two new tanks needs forms of any kind for its construction.

In constructing the two tanks, the following procedure was followed by the Ag. Engineering department:

Concrete Silo Stave Tank

Type—Single chamber vertical cylinder

Capacity—850 gallons (family of 8)

Size—6' inside diameter, 5' deep.

Operating depth—4'.

Materials—12 6" staves, 14 24" staves, 34 30" staves, 9 bags cement, 19

cu. ft. sand, 28 cu. ft. gravel, 1 gal. Aquella No. 2.

Excavation—diameter 7½', depth 7'. Dig sides vertically and level floor before pouring concrete.

Floor: 6" thick, made of concrete (1 part cement, 2 parts sand, 4 parts gravel, mixed to a smooth consistency.) The floor should cover the whole bottom and the concrete should be well worked when placed to form a strong level foundation for placing the staves.

Walls: Made of concrete silo staves 2½" thick, 10" wide and of varying lengths of 6", 24" and 30".

The joints must be staggered, so set 24" and 30" staves alternately in the first tier.

The tank is held together by 3 bands of ⅜" round steel rods tightened on opposite sides of the tank, with silo type lugs. The first band is placed 6" above the floor and tightened. The middle band is placed 3" below the top of the first tier of 30" staves and partially tightened after the next tier of 30" staves is placed over the top of the 24" staves. The remaining 30" staves are placed over bottom 30" staves. Now tighten middle band as much as possible. Fill in remainder of tank with 6" staves. Then place the top band just below the outlet tee and tighten.

Inlet and outlet tees: Place in the second tier of staves using 24" staves instead of 30" staves at this point to get the outlet tee 12" below the top of the tank. The inlet tee is placed 2" above the outlet tee. Plywood forms can be placed around the tees and a rather dry mortar can be worked into the forms with careful tamping around the tees.

Placing the outlet tee.



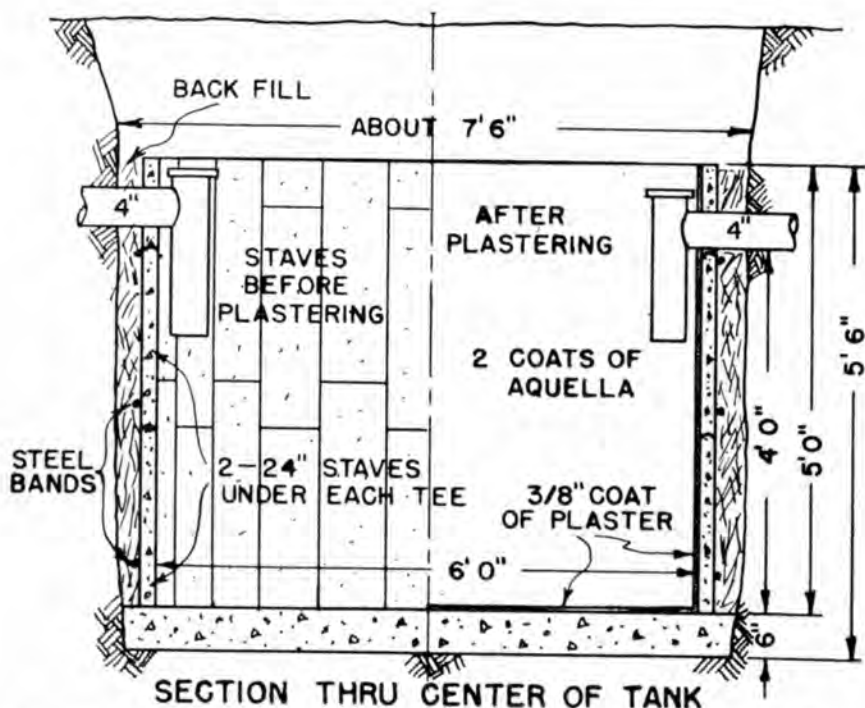


Diagram for a concrete silo stave tank of 850 gallons capacity. Drawing for cover on page 10.

Plastering: Apply a $\frac{3}{8}$ " coat of plaster of 1 part cement, 3 parts sand and $\frac{1}{4}$ part "cem-mix." Screen sand through a $\frac{1}{8}$ " screen. Before applying plaster, thoroughly wet the staves with water. Finish the plaster as smoothly as possible.

Allow to cure for at least 7 days.

Waterproofing: Curing of cement should be complete before waterproofing.

Apply two coats of Aquella No. 2 as per instructions. For best results, apply the first coat, mixed to a creamy consistency, with a stiff scrubbing brush.

The second coat should be applied 48 hours later with a paint brush.

Keep both coats damp for 2 days to get proper curing.

Cover: Reinforced concrete slabs, $4\frac{1}{2}$ " thick and 8" wide, of variable lengths as shown.

Mix 1 part cement, $2\frac{1}{2}$ parts sand and $3\frac{1}{4}$ parts gravel to a smooth consistency, so that the concrete bonds well around the reinforcing rods. Each slab is reinforced with two $\frac{3}{8}$ " knobbed steel rods, spaced 1" from the bottom, 2" from the sides.

Handles can be placed at both ends of the slab, using steel rods.

Forms will be needed to make these slabs, but used 2" x 6" lumber placed on asphalt paper on smooth hard ground will do.

**Costs for the Concrete Silo Stave Tank, Concrete Block Tank and
Monolithic Concrete Tank as at Brookings, 1948.**

Materials	Concrete Silo Stave Tank	Concrete Block Tank	Monolithic Concrete
Cement	\$10.35	\$17.00	\$18.40
Sand	1.07	1.95	2.25
Gravel	1.55	2.75	3.75
Reinforcing rods	4.80	2.00	2.25
Tees	2.70	2.70	2.70
Aquilla No. 2	3.95	3.95	
Lime	.50	.50	
Concrete blocks		21.00	
Rods, lugs and nuts	9.15		
Staves	18.00		
Form rental			10.00
TOTAL	\$52.07	\$51.85	\$39.35

Concrete Block Tank

Type—Single rectangular chamber

Capacity—550 gallons (family of 4)

Size—7' 4" long, 2' 8" wide, 4' 8" deep.

Operating depth—3' 9"

Materials—117 concrete blocks, 15 sacks of cement, 35 cu. ft. sand, 43 cu. ft. gravel, 1 gal. Aquella No. 2.

Excavation—9' 4" long, 4' 8" wide and 6' 9" deep.

Dig sides vertically and level floor before pouring concrete.

Floor: Same method as for silo stave tank.

Walls: 8" x 8" x 16" whole concrete blocks are laid in a mortar (1 part cement, 3 parts sand, ¼ part cem-mix). Tank is made entirely of whole blocks. Great care must be taken to keep blocks level and square at the corners. Use guide strings and square corners before laying the first course of blocks.

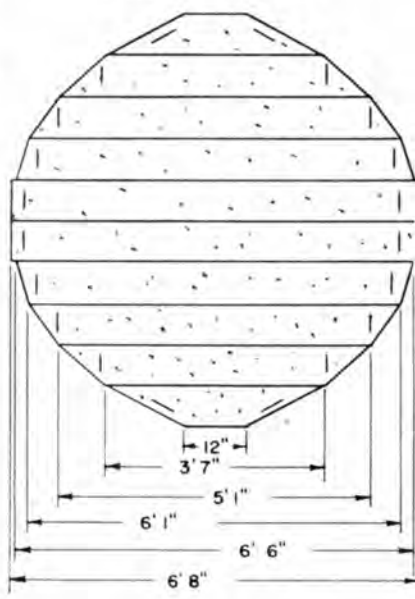
To add strength to the walls, stagger the vertical joints and fill the block cores with concrete (1 part cement,

2½ parts sand and 4 parts gravel not greater than ¾" material).

See drawing for insertion of the tees.

Cover: Precast reinforced cover slabs as for silo stave tank, but of uniform length.

Cover for silo stave tank.



Waterproofing: Two coats of Aquella No. 2 as for stave tank. Waterproofing should be tested by filling tanks with water. A third coat of Aquella may be necessary sometimes.

Both of these tanks can be made larger than described by using more staves in the silo stave tank, and lengthening or widening with more blocks in the concrete block tank. The basic method of construction remains the same.

Tanks should not be made smaller than outlined, because too small a tank will not operate satisfactorily.

A comparison of the materials for these two tanks, and also the poured concrete tank, is made in the table at the head of the preceding page.

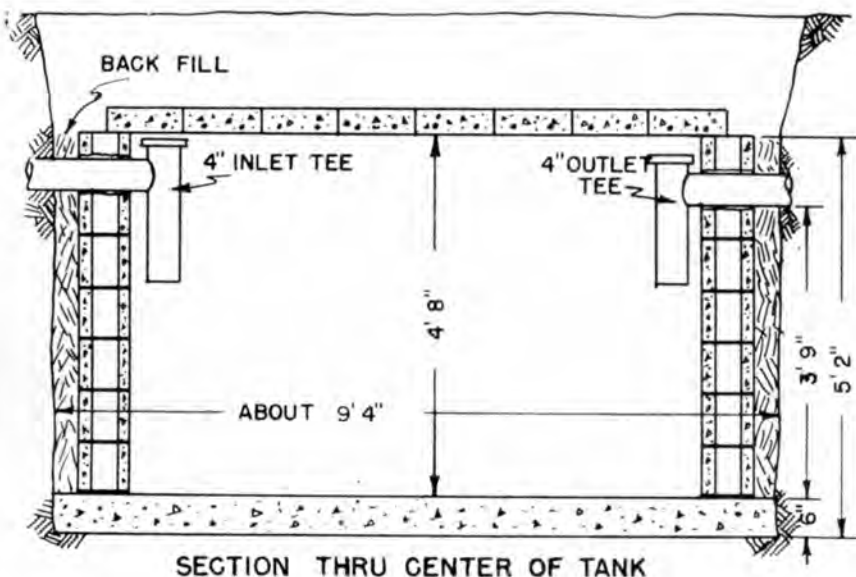
The concrete silo stave tank was built for a family of eight or more because there was a saving of only \$6 in

materials when designed for the smallest tank that should be made (550 gallons). The labor would be about the same for both size tanks. Even then, the cost of the smallest silo stave tank exceeds that of a poured concrete tank if forms can be rented for the poured concrete type instead of bought.

The concrete block tank also runs higher than the poured concrete tank.

Aside from cost, however, these two tanks have several advantages over the poured concrete type of tank. You do not need to build or rent forms; if aggregates are scarce or expensive, less aggregate is needed; staves or blocks are convenient to handle and transport and no concrete mixer or machinery is needed to construct them. (Project 165, Agricultural Engineering Department.)

The concrete block tank. Cover is made of precast slabs, the same as for silo stave tank.





The Dairy

By ARTHUR E. DRACY and
EMERY BARTLE

TODAY with the high cost of milk products, farmers are looking for a new and more economical means for raising dairy calves. Although many of the old and well established practices are still the best, they are by no means the most economical. Due to the high prices of whole milk and skim milk products, these means of feeding calves are being discontinued. Yet nothing has been introduced into the dairy calf diet which satisfactorily replaces milk.

Whole Milk

Whole milk is by far the best feed for young calves after the colostrum (first milk) has been utilized. (Colostrum can be easily stored by freezing during cold weather so that it can all be used, rather than discarding what the calf cannot drink daily.) However, those farmers who sell cream can profitably use skim milk by feeding 1 pound of skim milk for 10 pounds of live weight. Feeding more milk, although it won't harm the calf, may increase the cost of raising the dairy calf beyond the point where it is economical.

When the whole milk is sold, it has become necessary to look for new methods of raising dairy calves. Consequently, there has been a shift from feeding skim milk to feeding prepared rations such as dried skim milk, dried buttermilk, prepared calf meals, semi-solid buttermilk and whey.

Dried Skim Milk as a Substitute

Dried skim milk or dried buttermilk can replace liquid skim milk, either by mixing 1 pound of dried skim milk with 9 pounds of water to obtain the original composition of skim milk, or by mixing an adequate amount of dry skim milk or buttermilk in the dairy calf ration. Difficulties encountered in trying to dissolve powdered skim milk or dried buttermilk in water may be overcome if care is taken in the mixing process. Feeding powdered skim milk or buttermilk in a ground dairy ration may not be too desirable because the fine powder can get into the nostrils of calves and they may not eat as well as expected. The young calf, unlike the dairy cow, prefers larger pellets or whole grain while the older animals prefer ground feed.

Semi-solid Buttermilk

Semi-solid buttermilk, when available, can be used to feed dairy calves under the same conditions as dried skim milk. That is, add about 2 pounds of water to 1 pound of semi-solid buttermilk to ensure the natural composition. Although semi-solid

Calf Needs A Boost

buttermilk may be difficult to obtain, it will furnish a very nutritious feed for young dairy calves.

Whey

Whey (by-product of cheesemaking) is sometimes available for feeding dairy calves. Whey, which is the watery material of milk after the proteins and fats have been removed, contains largely lactose (milk, sugar), and may be used as a carbohydrate supplement. However, it must be remembered that whey, unlike the other dairy products, is not a protein-rich feed. Therefore, the calf should be fed some high protein concentrate to supplement proteins that have been removed from the milk. It should also be remembered that these vegetable proteins are not identical with milk proteins, and the results obtained may not be as good as those obtained by using some of the more complete milk products.

Calf Meals

Raising dairy calves economically and properly on a limited amount of milk may be done by employing a number of prepared calf feeds. Prepared calf feeds will ensure satisfactory results provided the directions prescribed by the manufacturer are followed. Usually, however, most calf rations will contain only the various home-grown grains plus a limited quantity of skim milk. In view of this, a number of experiment stations have studied the effects of various calf

meals fed at all ages. In general, the calf must be fed a limited quantity of skim milk (approximately two or three hundred pounds during the first 60 days). By this time the animal will be eating enough grain and hay to supply the body nutrients, and the skim milk may be reduced to a minimum or discontinued. These calves will not look as well nor make as rapid gains as calves receiving some skim milk product.

Cold Skim Milk Can Be Fed

There is still another type of feeding which may prove to be economical when large quantities of skim milk are always available. An experiment has been conducted at the Agricultural Experiment Station at South Dakota State College to determine some of the effects of feeding large quantities of cold skim milk to dairy calves. This experiment consisted of feeding the calf milk through a nipple feeder connected to a can of milk. To date, the calves have received cold skim milk after they have been weaned from the cow on the fourth day. Although the calves did not drink too readily the first day or two, by the third day they were eating as often as seventeen times a day. *This frequent eating seemed to reduce the quantity consumed at one time and also reduced the incidence of calf scours.*

Although some authorities believe that cold milk is unhealthy for calf feed, this experiment suggests that when the calf receives cold milk in rel-

atively small quantities it does not injure the animal in any way. Despite evidence that nipple feeders are insanitary, in these experiments, no animal became ill due to insanitary equipment. The nipples and cans were washed each day to reduce bacterial growth. However, if the cans and feeders were not washed daily the milk tended to sour before the third day. This is understandable, as for any approved dairy calf management, sanitation is of the utmost importance regardless of the method of feeding the milk.

In general, the calves receiving all the skim milk they wanted at any time, gained, on an average, from 15 to 25 percent more than calves receiving 8 pounds of skim milk. These measurements were made not only on gain in weight, but on chest measurements and height at withers. The chest measurement and height at withers indicated definite skeletal growth and that all the increased weight was not fat. In the same connection, even though the calves appeared to grow considerably faster than the controlled animals, they were always in condition for first-class

veal up until about 2 months of age. Thus, besides being a good way to utilize excess skim milk wherever possible, this may be another means of producing veal calves more economically than allowing them to nurse their dams or be fed whole milk for the 6-weeks period.

Whether it is economical to feed large quantities of skim milk to dairy calves must be decided by consideration of the price received for the calf at the time of the sale and the price that must be charged against the skim milk fed the calf. At the present time, this method of feeding shows much promise to the dairy farmer. (Project 191, Dairy Department.)

Not to be Overlooked

Not to be overlooked when raising dairy calves is the water supply. Although calves when very young do not drink much water, water should always be available. In the winter and the cooler months, young calves drink very little water, but in very hot months, all except the very young calves will drink a considerable quantity of water.

The calf on the left was raised on a nipple and received all the milk it wanted. It gained 33 percent more in 4 months than the calf on the right which was raised in the conventional way.



Don't Just Dig a Hole

By PAUL CARSON



YOUR NEIGHBOR gets 45 bushels of corn per acre and you get 30, and you want to know why. Or there is a hollow on your acreage that doesn't yield as well as the rest, and you think there must be a good reason.

So you decide to send in a soil sample to the State Soil Testing laboratories.

Time to Take Soil Samples

The best time of the year to have your soil tested is late summer or early fall. This is usually a slack period on the farm when odd jobs such as soil sampling can be done without taking valuable time from field work. But the most important feature of having your soil tested in the fall is that it gives you an opportunity to make your plans and order the necessary seeds and fertilizers. Soil management is not a tem-

porary program. It requires long term planning that will maintain maximum yields through the years ahead, and it is essential that these long term plans be flexible enough to take weather conditions and farm prices into consideration.

Get a Good Soil Sample

Soil testing is a cooperative enterprise in which you and the Soil Testing laboratory participate. Your part of this job is the most important because the tests are made on the soil sample you send. Recommendations for fertilizer use and suggestions for soil management practices are valueless if they are based on a soil sample that does not fairly represent the field. Obviously, a soil sample taken from an eroded side hill does not represent the soil found along the creek bottom.



Laboratory technician determining amount of available phosphorus in a soil.

Each area of different soil should be sampled separately. For example, take separate samples for light and dark colored soils, and of areas varying in slope, drainage, soil type, or past treatment (areas manured, fertilized and cropped differently). A soil sample that does not represent the area in which you are interested will lead to a false understanding of the fertility of the soil and may lead you to waste your money on unneeded fertilizer.

In collecting the sample, use a spade, trowel, or auger. Remove all loose surface litter and dig a V-shaped hole to a depth of 7 inches. Clean out the hole and cut a uniform 1-inch slice from top to bottom along the side of the hole. Collect this soil in a pail and continue to the next location. Repeat this sampling procedure in at least 10 different places within the area to be sampled. Then mix the samples well. Take one pint of this well mixed soil and you have your composite sample.

How to Prepare for Shipment

The soil sample should be spread out on a clean paper and allowed to air dry. Do not ship moist samples to the laboratory and do not dry samples in an oven as this interferes with testing. A good container to send your soil sample in would be a pound coffee can, or a clean ice cream container.

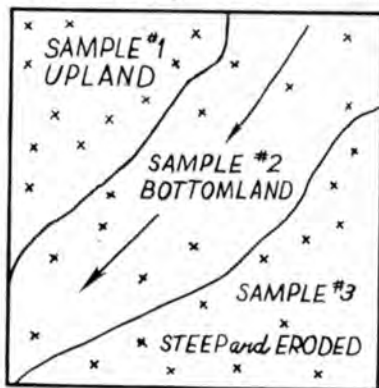
Label each sample on the map on the "Soil History Questionnaire," sheet.

Information Please

Soil testing can be compared to going to see your doctor. He can take your temperature, make blood tests, look at your complexion, etc., and know something about your health. But any good doctor will ask you a lot of questions. He will ask you questions about what you have been doing, your appetite, your digestion, your work and so on.

Likewise, chemical tests for available phosphorus, available potash, etc., give the agronomist a general picture of the fertility status of your soil. But

The x's show where soil was collected for each of three samples from a 40-acre field.



if you tell him only that you do not think the crop yields are as high as they should be, he does not have enough information. Further information is asked for in the Soil History Questionnaire, which accompanies Agronomy pamphlet 17, Soil Testing for South Dakota. Fill in the questions as completely as possible and add any information which you think may be of value to the agronomist. Soil tests are not perfect, but with the other information they provide a good understanding of the fertility status of a soil.

Tests Made

The tests now used are those found to work best for South Dakota soils. The Soil Testing laboratory has checked, and is continuing to check the tests against actual crop yields. If a

certain chemical test shows that the soil from the field needs 20 pounds of phosphorus (available phosphoric acid) per acre, and if the best yield follows an application of this amount, then the test is accurate.

Reports and Recommendations

After the tests are completed, you will receive a letter explaining the results found by the Soil Testing laboratory, together with recommendations for better soil fertility management. If you have further questions concerning the tests or soil management practices, you should either discuss them with your local county agent or write the Agronomy Department at South Dakota State College. (Project 172, Agronomy Department.)



County Agent Alvar Aho helping Gilbert Peterson plan a program for soil fertility and fertilizer use, based on tests made by the Soil Testing laboratory.

Applying recommended fertilizer by the plow sole method for corn.





Should We Feed Lambs Cobalt ?

By R. M. JORDAN

SHEEPMEN maintaining farm flocks, as well as lamb feeders throughout the United States, are concerned as to whether sheep rations should contain cobalt. There are feed companies who sell cobalt feeds to sheepmen in South Dakota on the basis that there may be a deficiency in this state.

Cobalt Content Varies

Cobalt has performed miraculously in some areas in the United States. However, the cobalt content in various types of soils varies materially, and what may be true in one part of the

country will not necessarily be true in another. The South Dakota Experiment Station has conducted a series of trials in which cobalt supplemented rations were compared with typical South Dakota lamb fattening rations. Two trials were conducted during the fall and winter of 1948-49. The lambs used in the first trial came from western South Dakota; the lambs used in the second trial came from Idaho. No information was available as to whether those two areas are deficient in cobalt, and inasmuch as we were interested in determining whether the

Table 1. Cobalt as a Mineral for Fattening Lambs—Trial No. I Nov. 11-Jan. 9—59 days

Lot number	I	II	III	IV
	Corn, hay, SBOM, 1½ oz. cobalt per 100 lbs. salt*	Corn, hay, SBOM, 1 oz. cobalt per 100 lbs. salt*	Corn, hay, SBOM, Plain salt	Corn, hay, SEOM, ½ oz. cobalt per 100 lbs. salt*
15 lambs per lot				
Initial weight	71.2	71.7	72.1	71.2
Final weight	94.1	94.4	95.7	91.3
Average gain per lamb	22.9	22.7	23.6	20.1
Average daily gain	.389	.384	.400	.340
Average Daily Ration				
Corn	1.94	1.51	1.90	1.60
Roughage	1.41	1.52	1.59	1.43
Soybean oil meal	.10	.10	.10	.10
Mineral mix	.03	.04	.04	.03
Feed per 100 lbs. gain				
Corn	502	395	476	470
Roughage	365	396	397	470
Soybean oil meal	24.6	26.0	25.0	30.0
Mineral mix	6.88	10.59	9.60	7.97

*Mixture of equal parts of salt and bonemeal.

Table 2. Cobalt as a Mineral for Fattening Lambs—Trial No. II Jan. 21-Apr. 16—85 days

Lot number	I	II	III	IV
	Corn, hay, SBOM, 1½ oz. cobalt per 100 lbs. salt*	Corn, hay, SBOM, 1 oz. cobalt per 100 lbs. salt*	Corn, hay, SBOM, Plain salt	Corn, hay, SBOM, ½ oz. cobalt per 100 lbs. salt*
14 lambs per lot				
Initial weight	68	68.3	69.2	68.7
Final weight	112.1	113.5	112.2	111.9
Average gain per lamb	44.1	45.2	43.0	43.1
Average daily gain per lamb	.52	.53	.51	.51
Average Daily Ration				
Corn	1.96	1.94	1.83	1.91
Roughage	1.60	1.58	1.58	1.59
Soybean oil meal	.10	.10	.10	.10
Mineral mix	.037	.034	.033	.028
Feed per 100 lbs. Gain				
Corn	379	366	359	375
Roughage	308	293	313	313
Soybean oil meal	19	18	19	19
Mineral mix	6.87	6.46	6.47	5.50

*Mixture of equal parts of salt and bonemeal.

feeds grown in eastern South Dakota contained an adequate amount of cobalt, that knowledge was not necessary.

The lambs in the two trials were full fed corn, alfalfa hay and soybean oil meal, with the supplement as follows:

Lot I—1½ ounces of cobalt in 100 pounds of salt and bonemeal mixed 50-50.

Lot II—1 ounce of cobalt in 100 pounds of salt and bonemeal, 50-50.

Lot III—Salt and bonemeal, 50-50.

Lot IV—½ ounce of cobalt in 100 pounds of salt and bonemeal, 50-50.

Results of the first two trials, given in Tables 1 and 2, indicate that there was no advantage in adding cobalt to the rations. The daily gain, feed requirements, and the cost per hundred pounds of gain were all quite similar.

No Advantage in Adding Cobalt

During the summer of 1949, two lots of lambs were put on experiment. These lambs were allowed to nurse their mothers on grass and received no feed other than grass. Lot I was fed a mineral mixture containing nine parts salt, one part phenothiazine and one ounce of cobalt chloride in 100 pounds of the salt and phenothiazine mixture. Lot II received a mineral mixture of nine parts salt and one part phenothiazine. Since the feeding of a mixture of salt and phenothiazine is a very common practice of sheep raisers in the corn belt, it seemed advisable to include the phenothiazine in this mixture to ascertain whether the phenothiazine and cobalt in combination had any toxic effects on the lambs.

The results shown in Table 3 indi-

cate that the addition of cobalt to the ration of growing lambs in eastern South Dakota was of no advantage. There was a tendency for the lambs receiving no cobalt to gain slightly faster than those receiving cobalt. The lambs receiving no cobalt gained .42 pounds per day compared with .40 pounds per day for those receiving cobalt.

Under the conditions found in South Dakota, which would apply to much of the corn belt, cobalt is not likely to cure all the trouble encountered in lamb feeding or lamb production. Intelligent feeding, management, and breeding are still the three keys to successful sheep production. Minerals will take the place of none of these. (Project 190, Animal Husbandry Department.)

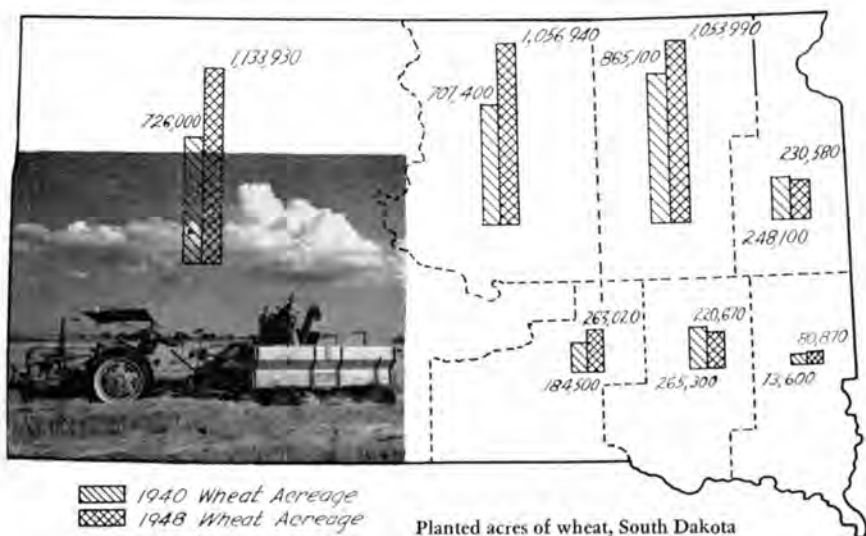
Table 3. June 7—August 22—76 days

Lot number	I Cobalt	II
	Pheno-Salt Mix	Pheno-Salt Mix
Number lambs per lot	15	17
Initial weight	54.67	56.56
Final weight	85.33	88.59
Average gain per lamb	30.66	32.03
Average Daily gain	.403	.421
Mineral Mix consumed per day	.043	.047



Mixed Hay Lowers Feed Costs

Feeding ewes a ration of one-third alfalfa and two-thirds brome grass can give as good results as feeding straight alfalfa, at about 20 percent less cost. Research workers at the South Dakota Experiment Station found during the past 3 years that this system of feeding provides a balanced ration over the entire period and produces better results than the feeding of grass hay for 3 months, followed by straight alfalfa. One-half pound of corn was fed to both groups the last month of pregnancy. (Project 162, Animal Husbandry Department.)



Overproduction Threatens Farm Income

By R. O. OLSON and GABRIEL LUNDY

FARMERS must produce less wheat or have smaller incomes. If we continue to plant 83 million acres of wheat in the United States, and have an average yield of 16 bushels per planted acre (about 1330 million bushels) market prices will drop; that is, unless the government pegs the price.

The Reason

Normally we use about 700 million bushels of wheat within the country for all purposes. Of this only about 490 million bushels are used for food, 80 million for seed, and 130 million bushels for livestock feed. If only 700 million bushels are used within the country, 640 million bushels must either be exported or put into storage,

and on July first of this year, we already had nearly 300 million bushels carryover.

Can we sell 500 or 600 million bushels of wheat each year to other countries? Yes, but not at prices to cover cost of production. We got rid of almost that much annually during the war years by helping the countries that fought our enemies. But we can't afford to help these other countries indefinitely. Neither can they afford to buy that much wheat at our prices. In fact, during the past 35 years our average yearly exports have been less than 170 million bushels. And in the years just before the war, we exported only 40 to 50 million bushels of wheat annually. As our aid to other countries

end, and as these other countries, out of necessity, increase their own wheat production, the question must be faced: What can we do about the wheat surplus?

What Can Be Done

The solution is a difficult problem. Two alternatives are commonly offered: (1) remove price supports, or at least lower the price support level, or (2) continue to support the price but reduce production.

We have, of course, selected the latter. The Secretary of Agriculture has announced a U. S. acreage allotment for 1950 calling for 17 percent less wheat acreage than this year. The allotment for South Dakota is 18 percent below the 1949 acreage, which means the planted wheat acreage in South Dakota will be down about 775,000 acres. The total United States wheat acreage will be reduced by 13 million acres. This is expected to reduce wheat production by about 200 million bushels. To the extent that this restriction results in reduced production, the surplus accumulation will be retarded, and the taxpayer's burden of supporting the price reduced, provided, of course, foreign production is not increased to offset this reduction.

Shift in Acreage Difficult

While an acreage reduction program may help substantially in reducing the surplus, it is not likely to be accomplished without some difficulty. Shifting 775,000 acres away from wheat in this state is no simple task. In the eastern areas of the state, wheat makes up only a small part of the total cropland. Many other crops can be substituted without a loss in income.

The problem is more difficult in the western and central areas where the wheat acreage makes up a very large share of the total cropland. Here farmers have fewer choices. In most of the western areas, at least, there is little question that much of the cropland should be returned to grass.

More grassland will mean more livestock. When the farmer raises more livestock, he is taking land out of grain and putting it into grass, and at the same time he is conserving his soil. As long as we have full employment and incomes stay up, meat consumption will be high and expansion in livestock production justified.

But regardless of the desirability of such a shift, there are serious obstacles in the way. Regrassing is slow, expensive, and not always satisfactory. During the period when a stand of grass is being established, the rancher not only bears the direct costs of reseeding, but must also sacrifice all income from that land. This makes the shifting of plowland to grassland especially discouraging to renters who often have no assurance that they will remain on the farm long enough to get the benefits of the new rangeland. Owner-operators who lack sufficient capital may also feel that they cannot afford to sacrifice income from this land during the period required to get a stand of grass.

While farmers in the central area have more crops to which to shift their wheat land, such shifts may still be difficult. Many of the farms in this region are organized for highly specialized and efficient wheat production. A shift to grass and feed crops will involve major changes in organization, investment, and type of farming, which many will find hard to make.

Nevertheless, such shifts toward more diversified production are desirable adjustments to both the physical environment and the economic conditions.

Why Restrictions Needed

Acreage restrictions do interfere with the farmer's freedom. Many object to such "regimentation." But sensible people realize that these restrictions may be necessary if we are to expect the government to support prices. By supporting prices at artificial levels we have removed one of the functions of price—that of equalizing production and consumption. If price is not free to do this equalizing by dropping in response to a surplus and rising in response to a short supply, something else must be used. Either we must (1) destroy the surplus, (2) subsidize increased consumption, or (3) restrict production. We have had some experience with each of these. We have been destroying large quantities of surplus potatoes, but it has been a costly and wasteful program. We have attempted to correct the surplus problem by increasing consumption through the Food Stamp Plan of the late thirties and the School Lunch Program. Such programs are useful in improving the country's dietary standards. It might be difficult and extremely expensive, however, to increase consumption of wheat enough to eliminate the surplus now in prospect.

Restrictions on production have also been tried before. Past experience has shown acreage restrictions to be ineffective in reducing total agricultural production, as we attempted to do under the Agricultural Adjustment Act of the thirties. Acreage controls are, however, very useful in shifting

production from one crop to another. As long as we are interested in merely shifting land from the production of one commodity which is over abundant to another for which there is sufficient demand, acreage restrictions appear to work quite well.

Problems of a Free Market

Now let us turn to an alternative solution to the surplus problem. Let the price of wheat drop. That is, either lower the price support level or remove supports entirely. Those who recommend this solution believe that the free market price is an automatic regulator or equalizer of production and consumption. This is largely true. Under a free moving market price, surpluses would not pile up year after year. Lower prices would encourage consumption, and discourage extensive wheat planting. But that does not mean that these adjustments would be made without cost. Indeed our farm programs and support prices have come about as a result of our dissatisfaction with the way price has performed its functions. Free market prices have moved up or down too far and too late. The extremely low price for hogs, for example, does not appear at the time of farrowing a bumper crop of pigs, but after these pigs are raised and coming on the market. By then it is too late to change production plans. A much smaller price change would have been sufficient to shift production had it occurred, or been known, at breeding time instead of marketing time. It is this poor production control performance of an unregulated price which has caused farmers to demand price protection. Returning to a free market prices does not constitute a solution. It merely admits an inability to solve the problem.

Protection Needed

The need for protection from the unpredictable changes of market prices of farm products is as great today as ever. But, it must be recognized that in supporting farm product prices in order to raise farm income, the government has an obligation also to take over the production and consumption control of price in order to prevent maladjustments in supply and demand. Such public controls of price, production and consumption should not, however, place undue burdens on taxpayers nor on consumers.

A price support program may save

farmers from financial hardship, but runs the danger of encouraging the production of surpluses rather than removing them. A price support program without controls is almost certain to do this. A realistic program to support farmer's incomes, it seems, should adjust production in harmony with (1) the need for farm products and (2) the physical adaptation of our land. In addition, full industrial employment should be promoted as a means of assuring larger and more stable incomes for both farmers and consumers. (Project 150, Agricultural Economics Department.)

CHANGES IN AGRICULTURAL PRODUCTION IN SOUTH DAKOTA

A high demand for U. S. farm products during the war and postwar years, together with several years of above normal rainfall, have brought about important changes in our state's agricultural production. Wheat acreage has increased nearly a million acres since before the war, and flax acreage is more than four times prewar.

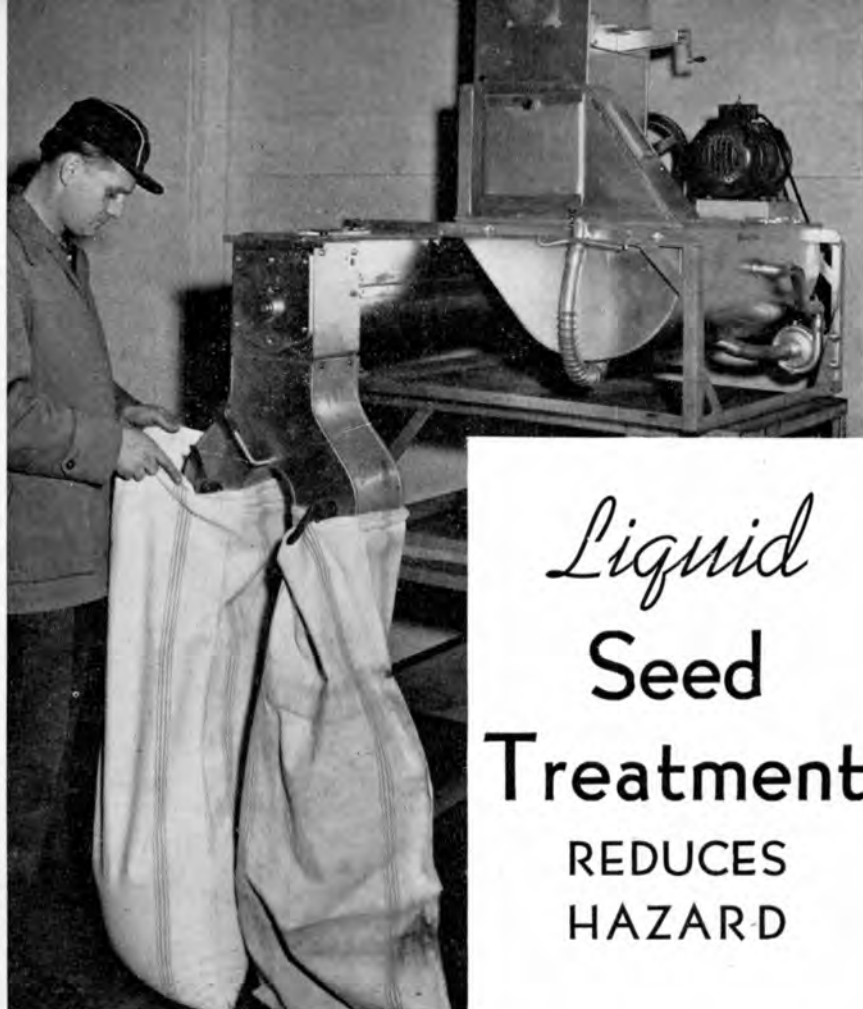
Spectacular changes have taken place in livestock production as well. The number of dairy cows has decreased by more than 20 percent, while the number of beef cattle has increased by more than 90 percent. Sheep numbers in the state have declined to about 56 percent of what they were before the war.

These production changes in South Dakota show the shifts in production throughout the country. Harvested wheat acreage for the entire United States, for example, increased from about 56 million acres in 1940 to 75 million acres in 1949.

WHEAT PRODUCTION AND PRICES

	U. S. Production 1,000 bu.	South Dakota Harvested Acreage 1,000	Yield per Acre	Production 1,000 bu.	Season Average Price Cents	Farm Value \$100
1938	919,913	3,095	9.1	28,227	66	15,230
1939	741,210	2,170	8.4	18,158	61	12,652
1940	814,646	2,693	9.8	26,261	70	17,885
1941	941,970	2,864	12.3	35,130	81	33,676
1942	969,381	2,630	17.2	45,274	97	48,530
1943	843,813	2,889	10.9	31,595	123	42,364
1944	1,060,111	3,058	12.7	38,847	141	54,322
1945	1,108,224	3,201	15.5	49,656	147	74,882
1946	1,153,046	3,588	14.8	53,197	172	104,798
1947	1,364,919	3,703	14.5	53,628	240	128,171
1948	1,288,406	3,848	13.1	50,391	215	102,977
1949	1,129,081	3,747		33,418		

S. D. Crop and Livestock Reporting Service; Agricultural Statistics, 1948, U. S. Department of Agriculture.



The slurry seed treating machine.

Liquid Seed Treatment REDUCES HAZARD

By C. M. NAGEL

CROP diseases are responsible for losses running into millions of dollars every season in South Dakota. These losses are indirectly sustained by each and every farmer and reflect on the general financial welfare of the state as a whole. Most farmers cannot afford to overlook crop practices which will reduce losses to their crops, just as most farmers know they can scarcely afford not to treat hogs to prevent cholera. Likewise, it is a recommended practice to treat seed for the prevention of crop diseases.

Recently some important improvements have been made not only in seed treatment materials themselves, but also in the type of equipment used in applying these chemicals to crop seeds. Those who have treated seed are aware of the dust problem arising from mixing the dry chemical with the seed. In some instances these dusts caused irritation to the skin, while others tended to be more or less toxic when inhaled by the worker.

Disagreeable Dust Problem Eliminated

A new method in treating seed has more or less eliminated most of the disagreeable effects associated with seed treating. This has been accomplished through the development of fungicides which can be used in liquid form and applied with machinery. This method is now known as the slurry treatment and makes it possible to apply these fungicides in a water mixture, virtually eliminating the dust which is the main hazard to the worker in seed treating operations. Many of the seed treating chemicals now being recommended by this Experiment station for crop seeds are now available, not only in the dust form but also in the slurry (wetable) treatment form.

Slurry Treatment Adds Water

The slurry treatment method consists of the addition of water to the dry chemical dust, which has been manufactured so that it will mix readily with water. The moisture added to the seed in this way is so small, if applied at the proper dosage, that it will not interfere with the keeping qualities of the seed, provided the grain was normally dry before the seed treatment was applied. The slurry treater is designed so that it is almost impossible to over or underdose once the proper adjustment has been made.

The slurry seed treaters now available are principally for large scale operations. The capacity ranges from 50 to 300 bushels per hour. It is planned that similar, smaller-sized machines will be made available which will be more adaptable to the needs of the smaller farms. However, as the situation stands now, this method is a dis-

ting advancement in the field of seed treatment.

Use Anti-freeze in Solution

In view of the fact that most people wish to treat their seed during the winter when the temperatures may be below freezing, it will be necessary to use an anti-freeze to prevent the treating solution from freezing on the machine and seed during the treating process. The anti-freeze to use is methanol (wood alcohol) or Zerone at the rate of 1 part of methanol to 2 parts of water and add treatment. This will reduce the freezing point to about 10 degrees below zero. Tests to date with a 1:2 mixture indicated no injury to wheat, oats, barley and flax.

It is advisable when using anti-freeze to exercise reasonable care by allowing for some ventilation in the room where the treating and storing is done to permit the escape of the methanol vapors resulting from the evaporation of the anti-freeze.

To date, tests have been conducted only with methanol as an anti-freeze and therefore it is the only material being recommended for the present. Also it is one of the cheaper types of anti-freeze, and it does not appear to injure germination.

Seed Can Be Treated in Advance

A good time to plan on treating seed is right after January first. Usually farmers have more spare time then, than if they waited until nearer planting time.

It will do no harm to the seed to treat it several months in advance of planting if seed is thoroughly dry before it is treated and if the proper treatment and dosage are applied. With such planning the farmer

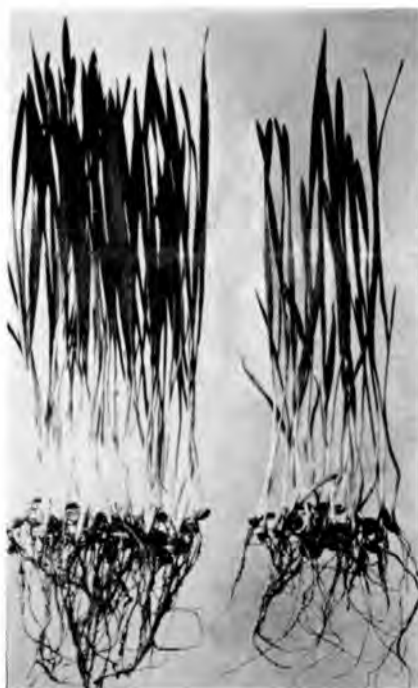
knows it will be ready to sow whenever the season warms up. The best results from seed treatment are obtained when the seed is treated at *least* a week or two before it is planted. Following an early spring and after the grain has been planted, it is not unusual to have periods of cold and freezing weather, and under cold soil conditions, the seed will not germinate. If the seed has been treated it will be protected from rotting and will be ready to germinate when the soil does warm up.

Controls Seed and Seedling Diseases, Smuts, Blights

Treating crop seeds with the proper fungicide (seed treatment) is a recommended practice for the control of certain destructive seed-borne diseases. It also provides effective control of most smuts, except the loose smuts of wheat and barley, and protects planted seed and young seedlings from attack by soil-borne organisms which cause seed decay and seedling blights.

Seed treatments will not control all types of plant diseases. When the right seed treatment is applied at the recommended dosage it will control bunt or stinking smut of wheat, smut of sorghum, seed rots of corn and flax, covered smut of barley, oat smuts, stem smut on rye and kernel smut on millet.

Accurate loss determinations in farmers' fields, made in the state during 1948 where heavy infection of bunt occurred, showed decreases in yield up to 33 percent. In addition, bunt-infected wheat receives a lower grade on the market because of its strong fish-like odor. If wheat carries only a trace of this type of smut it cannot be used for human food. Fortun-



Treated seed Untreated seed
Note that seed treatment improves stand and size of seedlings.

ately the proper seed treatment can be expected to control this damaging crop disease 100 percent. This disease has been on the increase during the past five years in South Dakota.

Will Not Control Loose Smuts of Wheat, Barley

Most seed treatments will not control the loose smuts of wheat and barley because the organisms responsible for these diseases live inside the seed and therefore cannot be killed without destroying the germination of the seed. However, they can be controlled by the hot water treatment. This is a delicate type of treatment and is recommended only where a grower wishes to eliminate loose smut from a small amount of wheat or barley to

get a new source of smut-free seed. Usually only a few bushels are treated for such purposes.

Most other diseases are carried on the surface of the seed and therefore can be effectively controlled by the application of the proper seed treatment. Seed treatments will not control such diseases as stem and leaf rusts of wheat, barley, oats, rye, flax, or corn smut and most foliage diseases.

Not All Seed Treatments Satisfactory

Not all seed treatments available on the market are satisfactory. Frequently seed treatment materials are placed on the market which may be either ineffective or inadequately tested under disease conditions present on the farm lands of this state. New seed treatments are not recommended by the Experiment Station until sufficient experiments under field conditions have clearly demonstrated that they are effective in controlling certain crop diseases, or that they possess some other outstanding advantage.

New Compounds Tested in 1949

During the 1949 season, seed treatment experiments were conducted on wheat, oats, barley and sorghum. Fifteen different treatments were tested on these crops except in the case of flax, in which 29 materials were under field plot tests. Many consisted of new compounds, along with some of the currently recommended seed treatments, to determine whether some of

the newer formulations might be more effective than the treatments now being recommended.

Consult Station Before Using

Soil-borne diseases frequently may vary from one state to another and particularly from one region to another; therefore, we cannot recommend a new fungicide until we have experimental evidence collected under field conditions in the state to determine if it is equal to, or better than the currently recommended materials. Before using any new seed treating material it may be advisable to contact your county agent, or your State College Experiment Station.

Improved Yield, Stand, Quality of Grain

Seed treatment is one of the cheapest forms of crop insurance. It costs only a few cents per bushel, and, on the basis of field experiments conducted by the Plant Pathology department, yield increases have been obtained of two to three bushels per acre in flax, up to 10 bushels in oats and as much as 11 bushels in sorghum.

Additional information on various aspects of seed treatment, or on crop disease control, as well as plans for homemade dust treaters, may be obtained by contacting your county extension agent or by writing to the Plant Pathology department at South Dakota State College, Brookings.

(1) All seed should be cleaned before it is treated.

(2) Treat only enough seed to plant the acreage intended.

(3) Treated seed which is left over should not be fed to livestock as it may cause death.

Because most seed treatments are toxic to both humans and livestock, especially when they are exposed to such materials over prolonged periods, it is important to use caution in their use around the farm. Avoid accumulation of mercury dusts on moist skin. (Project 115, 110, Plant Pathology Department.)

Deep Freeze or Locker Plant

HOW DOES the cost of owning and operating a home freezer unit compare with the commercial locker

MEAT

By ELLIS A. PIERCE

plant? This is a broad question and several factors will have to be considered in arriving at an answer. Some of the more important of these are:

1. The initial cost of installation.
2. Cost of operation, such as power rates and upkeep.
3. Depreciation.
4. The individual cost of transportation to and from the commercial locker plant.
5. The value received from the convenience afforded by owning a home freezer. This is an individual item and must be considered separately for each case.

These factors enter into the cost of owning a home freezer and must be taken into consideration. Problems may also be encountered which are beyond the control of the individual owner, such as power failures or mechanical breakdowns which result in thawing and possible spoilage of food. However, in most instances these stoppages in operation are not of sufficient duration to be serious, but they should most definitely be considered.

2-year Study Made on Home Freezers

A summary of two years' work, which included studies on three types of home freezers and a commercial locker plant, was used in making comparisons. The major items compared were:

1. Operating costs.
2. Effect of size and construction.
3. Rate and capacity of freezing.
4. Effects of wrapping materials.
5. Quality retained in the stored meats.

Operating Costs Figured for Home Freezers

All costs were calculated for an 8-cubic-foot home freezer and were based on power rates of the Brookings Municipal Power Plant. A power consumption range of from 40 to 210 kilowatt hours was used, as this amount represents the average farm consumption per month for the eastern section of South Dakota. Using these rates and consumption ranges, the cost of operating a freezing unit was three cents per kilowatt hour.

The normal freezing period required approximately 12 hours and an average of two kilowatt hours of power. The storage periods consumed only 1.5 kilowatt hours for each 24-hour period. On this basis, the cost of storage operation was \$16.40 per year and the freezing cost was similarly calculated to be 37.5 cents for each 12-hour period.

Locker Rates Compared

Locker rates at the local locker plant for a 5.1 cubic foot capacity locker are \$10.00 and \$12.50 per year with a \$.65 insurance fee and a \$.50 key deposit added to the rental fee. A charge of 2½ cents per pound was made for the cutting, wrapping, and freezing of

meat and 2 cents per pint for freezing vegetables and fruits. It must be remembered that services rendered to patrons vary within rather wide limits and the charges for these services also vary widely among plants. To compensate for the difference in size between the commercial locker and the home freezer units, the locker rental fee was adjusted to make an equal capacity comparison of lockers and freezers possible.

The following comparison shows the freezing costs for 200 pounds of meat and 50 pints of fruits and vegetables. This amount could have been frozen easily during one period by the commercial locker, but required six freezing periods for the home freezer. The extra freezing periods for the home units were necessary in order to conform with recommended loads of three to four pounds of meat per cubic foot of freezing capacity.

Locker Plant (1 freezing)	
Locker rental (8 cu. ft.)	\$20.25
200 lbs. meat at 2½ c lb.	5.00
50 pts. fruits and vegetables, at 2c each	1.00
Total cost per year	\$26.25
Home Freezer (6 freezings)	
Operational cost per year	\$16.40
6 freezing periods at 37½c	2.25
Total freezing cost per year	\$18.65

An annual saving of \$7.60 was made where only operational expenses were figured in the total home freezer costs. However, this is not sufficient to cover depreciation of the unit or cost of paper and supplies necessary for home processing. Neither does it allow for any insurance in case of spoilage or loss of meat or other food products. This factor is of great im-

portance where inexperienced persons are doing the processing.

Types of Home Freezers Compared

Each of the two common types of home freezers has its advantages and disadvantages. The deep chest type has the advantage of physical design to retain coldness, in that heat enters with greater difficulty when the door is opened. In contrast, the opened door of the vertical type literally "pours" cold air from the bottom, which is replaced by warmer air near the top of the cabinet. It also was found in this study that freezers of the deep chest type required less time to reach sharp freezing temperatures. This fact was attributed to the greater cold-retaining ability of this type during the loading period.

Home Freezers Have Faster Freezing Rate

Quick freezing or sharp freezing is one of the primary concerns in the freezer locker business. Without this process, freezing would spoil more food than it would preserve. Therefore, it is important that owners be familiar with the powers and limitations of their home freezer units. For this reason, freezing rates of the different units were compared. The results of this comparison showed that all home units studied had a faster freezing rate than the commercial locker, one unit freezing nearly half again as fast.

Wrapping Material Affects Freezing Rate

In addition to type of freezer, type of wrapping material also affected the freezing rate. All meat cuts wrapped by the No-Air method froze in less

time than the cuts that were wrapped in paper. The latter show only slight variations in rate of freezing.

Smaller Losses in Weight for Meat Stored in Locker

Losses in weight of the different cuts as a result of freezing and storage were considered a quality reducing factor and, therefore, were compared on freezing units and wrapping materials. This comparison revealed smaller losses in weight for all meats frozen and stored in the commercial locker than for any frozen and stored in the home units.

When wrapping materials were considered separately, the wax, locker-paper-wrapped meats had an extremely large loss in weight during freezing and storage. As a result of these losses, the meat was of much poorer quality after freezing and storage than it was originally. Much dehydration had taken place, but this may have been due to the fact that only one thickness of paper was used in wrapping. It is suggested that all meat cuts be wrapped with two thicknesses of paper if this type wrapping is to be used.

Only limited information was obtainable from this study on the rate and capacity of freezing, but other workers have suggested an optimum load of from three to four pounds of meat or other products for each cubic foot of freezing capacity during any one 24-hour period. This was substantiated in this study by the increased length of time required for freezing when freezers were loaded beyond this amount.

Food "Turnover" Important

Still other factors need mentioning.

The length of time different kinds of meat will keep under storage conditions, and the need for accuracy in dating and labeling must be understood. *Research has definitely shown that length of storage has a direct relationship on the quality of frozen meats.* It is important that recommended storage periods be observed in order to insure the retention of high quality.

In this connection, "food turnover" is important. *The efficiency of storage operation depends upon the availability of space to accommodate products purchased at a saving.* With this fact in mind, it is easily understood why it is important to use up stored frozen foods. Otherwise, quality is lost and valuable space occupied.

The home freezer is excellent for freezing small quantities of meats, fresh fruits, or vegetables. Its freezing efficiency and quality-preserving ability are greatly impaired if large amounts are attempted.

It would be advisable to use the experience and facilities of the commercial locker operator in those instances where a large quantity of meat is to be processed. The home freezer could then serve as a storage unit for the food products. This system of operation would enhance the efficiency of the home freezer by permitting the owner to take advantage of the lower processing costs of the commercial operator as compared to home processing, and also enhance the quality of his meals by having a greater assortment of fresh foods at home. (Project 158, Cooperative. Leaders: Ellis A. Pierce, Animal Husbandry Department; H. H. DeLong, Agricultural Engineering.)



LIDA M. BURRILL and BETH ALSUP

ALONG with the increased use of home freezers have come many questions concerning the use of this new piece of household equipment. Will food freeze as fast in one freezer as in another? Does slower freezing seriously affect the palatability and nutritive value of foods? And of course there are questions about the relative merits of the many types of packaging materials and containers.

Cherries, Green Beans, Corn and Peas Tested

Whereas the Animal Husbandry department studied the freezing of meat, the Home Economics and Horticulture departments worked with fruits and vegetables. Nanking cherries, green beans, and corn were used in 1947-48, and garden peas were included in 1948-49.

Three home freezer units were purchased. Two of them were of the chest type, one having a separate freezing compartment, while the third was an upright freezer with drop-front shelves.

In addition to comparing the efficiency of the three freezers in preserving palatability and nutritive value, several types of packaging were studied: (1) the cellophane bag inside a waxed carton, (2) the polyethylene liner in a waxed carton, (3) a plain waxed carton, (4) glass jars, and (5) an aluminum foil container.

FRUITS and V

in the home freezer

Method of Preparing Food

Each food was prepared for freezing according to accepted methods. The cherries were pitted and mixed with sugar in the proportion of one pound of sugar to four pounds of fruit. Freshly harvested beans were stemmed, washed, scalded for four minutes in boiling water and chilled in ice water. Immediately after harvesting, the peas were shelled using the shelling attachment for a home mixer, scalded for 2½ minutes in boiling water, and chilled in ice water. After husking, the corn was scalded for 4½ minutes by placing six ears in six to eight quarts of boiling water, chilled in tap water and then in ice water, and cut from the cob.

After thoroughly mixing the entire amount of each food, samples were removed for ascorbic acid determinations, and the containers filled, the same amount being weighed into each one. A thermocouple for measuring the temperature of the food was placed in the center of each package. Duplicate packages of each food in each type of container were then placed in each of the three freezers, the cold control switch on each box having been turned to "freezing" position several hours previously.

The temperature at the center of each package was recorded at 15 minute intervals until each one reached 0°F. When the last package registered a temperature of zero degrees, the cold control switch was adjusted for "storage." The packages of frozen

ETABLES . . .

foods were stored in the same freezer in which they were frozen.

Some of the results for green beans are shown in the accompanying graphs. Those for corn followed much the same pattern. In these diagrams a few observations stand out: (1) there were small but consistent differences in the rates of freezing in the three freezers; (2) the rate of freezing was higher in 1949 than in the preceding season; and (3) the beans in the foil containers froze at a considerably faster rate than those in any of the other types of containers used.

Container Important in Rate of Freezing

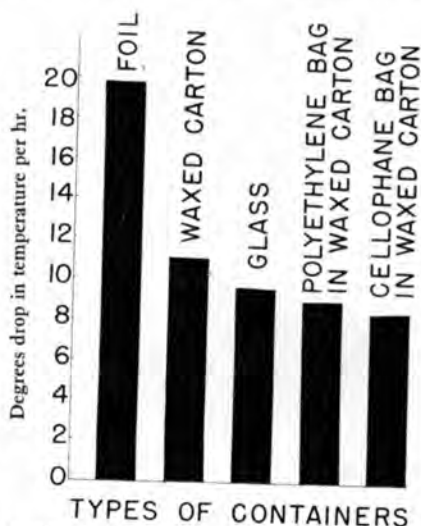
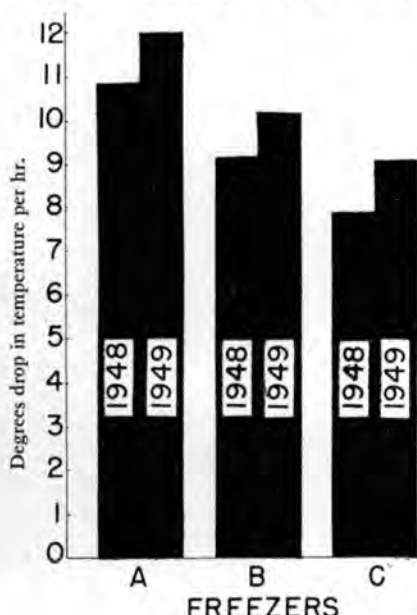
The type of container would appear to be more important in determining the rate of freezing than the type of freezer. That the quantity of frozen

food already in the freezer may be another factor in determining the rate of freezing is indicated by the fact that in 1948 the freezers were more than half full of frozen meat whereas in 1949 the freezers were practically empty at the time the freezing tests were made.

No Differences Detected in Appearance or Palatability

After storage periods of 3 to 4 and 9 to 10 months, sample packages were removed for ascorbic acid determinations and palatability tests. The cherries were defrosted and tasted without further treatment. The vegetables were cooked, without previous defrosting, until tender, and, while still warm, were served to a taste panel consisting of six trained judges. No consistent differences in appearance or palatability have been detected between the samples frozen in the different freezers or in the different containers.

Since the data on ascorbic acid is still incomplete, it will be reported later. (Project 98, Home Economics.)



Comparison of the rate of freezing for green beans.



Placing soil moisture blocks in soil to record moisture conditions during growing season.

Looking Ahead to Irrigation

Redfield Soil Studies

By L. O. FINE

RECENT Congressional support of the Missouri Basin development program forecasts marked changes in South Dakota's agriculture. It is proposed to irrigate about 750,000 acres in east-central South Dakota, and if accomplished, this will have quite marked effects on agriculture in the state. Some more intensive crops will doubtless be grown, increased quantities of legume hays will be produced, and considerable shift in farm operations may be anticipated in, and adjacent to, the areas actually irrigated.

In any shift new problems regarding crops, soils, and crop rotation systems generally arise. In order to find

answers to some of these problems, the South Dakota Experiment Station entered into an agreement with the Bureau of Reclamation to conduct experimental work under irrigation at the Redfield Development farm, located 7 miles east of Redfield. Work was begun in 1949 with field experiments in rotations, crops, fertilizers and various soil management practices. Also, some preliminary work on fertilizers was done on a restricted basis in 1948.

Plots Established

Over 150 plots involving experiments with soils, fertilizers and rota-

tions were established in 1949 and will be continued for an undetermined time. In order to compare dryland with irrigated yields, half of the experimental area is irrigated and half is not. The main object of rotation studies is to determine the most desirable length of time the legume should remain in the rotation. Fertilizer studies are set up to test manure and various combinations of commercial nitrogen, phosphorus, and potassium as they influence yields. The effect on soil properties of manure and legumes plowed under is also to be determined. Soil samples from plots are taken to determine chemical and physical effects of practices used on the soil itself.

Soil Moisture Recorded

The amount of moisture in the soil was recorded in both irrigated and dryland plots by means of electrical resistance gypsum blocks. These blocks are buried in the soil at various depths and contain electrical terminals connected to lead wires which are brought to the surface. The electrical conductivity is proportional to the moisture content of the soil and can be read in a few minutes by means of a special type of conductivity bridge. Readings from these blocks can also be used to determine when it is necessary to apply irrigation water.

Yields for 1949

Corn responded to nitrogen fertilization quite markedly, with a 13 bushel per acre increase in yield resulting from 60 pounds of nitrogen per acre. Increasing the nitrogen rate up to 140 pounds per acre increased the yield only slightly, giving 56 bushels per acre as compared to 50 bushels per acre for 60 pounds of nitrogen. This is an average of all plots receiv-

ing these two treatments. Phosphorus and potassium fertilizers did not materially increase yields. The use of manure instead of commercial fertilizer to supply the nitrogen did not give satisfactory results this particular season.

In the 1949 season, corn on dryland plots yielded about one third (17 bushels per acre) as much as corn on irrigated plots.

Wheat, like corn, responded in growth and yield mainly to nitrogen, and only very slightly to phosphorus. This was true of both irrigated and non-irrigated plots. Average yields of irrigated wheat were 9.9 bushels per acre for all plots not receiving nitrogen and 23.3 bushels per acre for all plots receiving nitrogen fertilizer. Non-irrigated wheat yields averaged 9.8 bushels for all plots not receiving nitrogen compared to 18.8 bushels for all plots receiving nitrogen.

Land Leveled for Irrigation Needs Nitrogen

To determine the best means of rapidly bringing leveled areas into high production, various combinations of commercial fertilizers, fertilizers plus straw, and manure were applied to plots from which topsoil had been removed. These treatments were made in 1948 and 1949. Results thus far indicate that very large quantities of nitrogen must be applied to leveled lands in order to get good growth and yields of crops. This means a fertilizer application of at least 90 pounds of nitrogen per acre and preferably 120 to 150 pounds. Very heavy applications of manure (40 T. per acre) had some effect, but apparently not as marked as that of commercial nitrogen. (Project 173, Agronomy Department.)



Modern home of one of the successful farmers on the project.

By W. F. KUMLIEN

BECAUSE of its possible bearing on the proposed Missouri River Basin Development, now in the process of formation, many farm families will be interested in developments in the Belle Fourche irrigation project which has been in actual operation for the past 38 years. A study has recently been made indicating significant social adjustments that have taken place in western South Dakota irrigation during the past four decades.

Want Children to Farm

Perhaps the best evidence that project families like irrigation farming is the fact that the great majority of parents interviewed on the project testified they wanted their children to farm and had definitely made an effort to interest them in farm life, by having the children study agriculture and homemaking in high school and belong to 4-H clubs.

Many of the present operators worked their way up the "agricultural ladder," starting as laborers, then tenants, and finally as owners. In recent



Newell high school where many of the children of the

years a large number of operators purchased additional land which previously had been lost by foreclosure and had been taken over by either the state or county during the drought and depression period. Under the limitations of project irrigation the family unit with one deed could not own more than 160 acres. It was possible, however, for the wife to own separately another quarter section, or in some instances, extra quarter sections could be deeded to a son or daughter who was 21 years of age or older.

An interesting sidelight on farm parents' favorable attitude toward irri-

families Like Irrigation FARMING



project study agriculture and home economics

gation farming was that out of 53 families interviewed, at least 10 of them had retired on the farm. They explained that with the rapid developments taking place in farming there was still much light work they could do, such as making home improvements, taking care of the garden, or occasionally helping to irrigate.

Early Irrigation Project

This project is located in the northwest part of South Dakota and was started in an area much less developed agriculturally than the Missouri river basin. It was thus naturally slow in

getting underway and in over-coming the agricultural customs and habits of the western ranching region. It should also be pointed out that the project was started a number of years before present day developments in modern agriculture. Even without irrigation, the Northern Plains states have passed through revolutionary technical changes in agriculture and home-making since the middle thirties. These changes have paved the way for irrigation.

Another important factor in trying to estimate the rate and degree of irrigation progress in western South Dakota lies in the nature of its soils. West of the Missouri river, the soils have not been glaciated but had their origin from the bottom of an old sea bed, extending from the Hudson Bay area to the Gulf of Mexico. About three-fourths of the Belle Fourche project soil is popularly known as "gumbo." This soil type is difficult to manage under irrigation. The fertility of "gumbo" soil is fairly high but difficult to handle because of its compact physical structure. The "gumbo" soil has a shorter cropping season than sandy loams and is much better adapted to certain types of crops than others.

It may be pointed out, also, that during the first decade (1911-1921) much more emphasis was placed on the engineering features of the project

than on its agricultural development. The Federal Experiment Station near Newell, established at the beginning of the project, did not have as much local experience in comparing irrigation farming with that of dry land methods as it does today.

Well Integrated Community Life

One of the most encouraging factors of the project is the closely knit relationship between town and country. Like most areas in western South Dakota there were a number of small neighborhood service agencies established. This, in part, was due to poor roads, horse and buggy transportation, and the fact that there were innumerable improvements to make on a new irrigation project. It was not until after the depression period that net incomes were sufficient to modernize the farms and provide for community services. Since then, decided improvements have been made in road conditions, power lines, REA and the expansion of service agencies in towns.

Practically all churches are now located in towns, also health facilities, recreational life, and high school education. Even rural elementary schools are beginning to decline both in number and enrollments and many children are being sent to public grade schools in town. These and other similar trends have been made possible by larger incomes per family on the project than in other nearby non-irrigated communities, and because farm families are becoming accustomed to making more and varied contacts in towns and villages in that area. In many respects this better relationship between town and country also has been made possible because of a more

thickly settled population and smaller farms.

Larger Net Farm Incomes

Comparisons were made between the irrigated family farms on the project and the dry land farmers in surrounding communities in northwest South Dakota. During the past decade the income from irrigated land has proved to be consistently larger. This was shown to be true in spite of fairly good rainfall on dry land farms during the past 9 years.

Farmers gradually have learned that irrigation water should not be considered as merely supplementary to rainfall but should be applied to crops without delay when needed. Formerly the tendency was for farmers on irrigated farms to wait for rain, thinking that it would probably come within a few days. Careful studies show that to produce maximum crop yields, the application of irrigation water required very careful timing.

Stabilized Farm Life

While good crops can be raised in normal rainfall years in most parts of South Dakota, there are seasons when rainfall is below normal or unseasonable, producing only a fraction of a crop. This is seen more clearly when examining a rainfall map with a corresponding map indicating annual average crop yields. Leaving out losses from such hazards as grasshopper ravages, hail, etc., widely varying yields can be equalized so that the income is made consistently more stable under irrigation.

From 1930-40 the combined drought and depression was so serious, that between 35 and 40 percent of the farms in the state were taken over by foreclosure. Much of this could have been avoided if the operators

could have continued on the farms without having to dispose of their livestock, equipment, and without losing title to the farm. Three different decades have passed since 1911 in which western South Dakota farm operators lost heavily through a collapse in farm prices in 1921. The following decade from 1920 to 1929 ended much the same way preceding the drought and depression period.

The period from 1930 to 1940 is easily understood as a difficult one in practically all parts of the United States. Even under the Belle Fourche irrigation it became evident that a new contract with the government was necessary for farmers to "pay out" under prevailing conditions. There were 166 farm mortgages foreclosed by the county or state because farmers could not pay their water charges nor taxes. To meet the problem, the water charges were reduced by the U. S. Reclamation Service, based on a 10-year land-use survey followed by a complete reclassification of all irrigable land. The nine years from 1941 to 1949 have been more prosperous due to good yields and high prices.

Today's Irrigation Farmer

Prospective irrigation farmers of today can start in a much more advanced stage of agricultural development than was possible 38 years ago. Scientific research, practical experience, extension demonstrations and instruction in both agriculture and homemaking are rapidly displacing the former "trial and error" methods.

Because of more thickly settled population and smaller farms or irrigation projects, a much closer town-country relationship has been built up. New discoveries and inventions, improved communications and transportation are all playing their part.

Larger net incomes through more efficient production have made it possible to build up a much better reserve of working capital in this period than was true when the Belle Fourche project was begun.

In spite of earlier difficulties and occasional set-backs, project families feel that farm life has been stabilized and they like irrigation farming. (Project 64. Rural Sociology Department.)

More farmers each year are raising alfalfa under irrigation for winter feeding.





Norghum

... ITS FEED VALUE FOR LAMBS

By R. M. JORDAN

LIVESTOCK men naturally are eager to know how good a feed Norghum is in comparison to the grains that normally are grown in the Northern Great Plains area. Norghum shows promise of producing a feed crop in areas where corn and small grains perish for lack of moisture. Heretofore, livestock men have had to rely on sorghums developed in the southwest. These sorghums were too slow in maturing and could not stand the cold springs that we have in this area. They were of necessity planted late in the spring and usually were frosted before they were mature.

Previously experiments have shown that when sorghum is fed to beef cattle, or swine, as ground grain, it is worth about 90 to 95 percent as much as corn. However, lambs seem to be the most efficient in the utilization of grain sorghums, as it has been found that sorghum grain is about equal to corn when fed to fattening lambs. Grain sorghums do not have to be ground when fed to

lambs and are fed in exactly the same way as one would feed shelled corn.

To determine the actual feeding value of Norghum in comparison with corn, the South Dakota Agricultural Experiment Station conducted a lamb feeding trial during the fall of 1949. Lambs that originated in the central part of South Dakota were purchased and placed on feed the early part of October. These lambs were all vaccinated for overeating disease and were fed as follows:

Lot I received a full feed of whole Norghum sorghum, brome hay, and 10 percent, by weight, of the grain ration of soybean oil meal. The ration for the major portion of the experiment supplied the lambs with about 65 percent grain and about 35 percent roughage.

Lot II was full fed shelled yellow corn, plus 10 percent soybean oil meal and brome hay. This ration consisted of about 60 percent concentrate and 40 percent roughage.

The Norghum fed in this trial weighed 56 pounds to the bushel, as did the shelled yellow corn. Norghum

was very palatable as the lambs ate more per head daily than did those receiving yellow corn. The results of this experiment are given in Table 1. This information is in the nature of a progress report and another trial will be conducted later this winter.

This experiment indicates the following results:

1. The new variety of sorghum, named Norghum, is a palatable feed for lambs.
2. It does not have to be ground when fed to lambs.
3. It is as easy to keep lambs on feed when feeding Norghum as when they are being fed corn.
4. Daily gains made by lambs receiving Norghum during this experiment were equal to, or excelled, the gains made by lambs fed shelled corn.

Digestibility of Norghum Determined

To determine the digestibility of whole Norghum sorghum with lambs in comparison to the digestibility of other grains, a digestion trial was con-

Table 1. Comparison of Norghum Sorghum and Shelled Corn as a Feed for Fattening Lambs

	Lot I—Norghum Sorghum Soybean Oil Meal, Brome Hay	Lot II—Shelled Corn Soybean Oil Meal, Brome Hay
Lambs per lot	25	25
Days on feed	75	75
Initial weight, pounds	70.7	70.5
Final weight, pounds	95.5	95.0
Total gain per lamb, pounds	24.8	24.5
Average daily gain, pounds	.331	.327
Average daily ration, pounds		
Norghum sorghum	1.72	
Shelled yellow corn		1.64
Soybean meal	.17	.16
Brome hay	1.18	1.19
Feed per 100 pounds gain, pounds		
Norghum sorghum	513	
Shelled yellow corn		495
Soybean oil meal	51.3	49.5
Brome hay	351	358

ducted at the same time. Four lambs were placed on trial and fed slightly less than two pounds of Norghum a day. No hay was fed during the trial. The preliminary period was of 10 days duration as was the collection period.

To illustrate: The lambs are fed the feed to be tested 10 days before the trial starts; this eliminates contamination from some other feed that may be in their digestive tract. This is called the preliminary period. At the beginning of the next 10 days (collection period) a sack is fastened to the lambs to collect the feces.

All the feeds that are fed are weighed accurately as are the feces. Chemical analyses are made on the feed and the feces, and the apparent digestibility is calculated. For example, if a lamb ate 2 pounds (dry basis) of feed that contained 10 percent protein and 1 pound (dry basis) of feces was excreted that contained 5 percent protein, the apparent digestibility of protein of that particular feed would be 75 percent.

Chemical analysis of the Norghum fed is given in Table 2. This shows the percentage of each nutrient that is in the feed. The results of the digestion trial are given in Table 3, and show a comparison of Norghum to shelled corn.

A considerable amount of the sorghum passed through the lambs whole, but in spite of that, the digestibility compares favorably with corn and further substantiates the results of feeding trials, that grinding sorghum is not economically practical.

Norghum sorghum offers to the farmers and ranchers in South Dakota a drought-resistant grain that is about equal to corn in feeding value and yield, and should enable many feeders to stabilize and, in many instances, expand their operations. Its ability to withstand the cold damp weather during early May, its early maturity and high yield are but a few of its many virtues that are giving livestock men in South Dakota new hope. (Project 123, Animal Husbandry Department.)

Table 2. Chemical Analysis of Norghum Sorghum and Corn*

	Total dry matter	Digestible protein	Total digestible nutrients	Protein	Ether extract	Fiber	N-free extract	Minerals
Norghum	91.17	9.04	82.04	12.15	2.79	1.78	72.97	1.48
No. 2 Corn	85.2	7.1	80.6	9.4	3.9	2.2	68.4	1.3

*The above table shows the relationship between Norghum sorghum and No. 2 Dent corn. This analysis indicates that Norghum is superior to corn in all constituents, with the exception of ether extract.

Table 3. Digestive Coefficient of Norghum Sorghum When Fed To Lambs Without Roughage

	Dry matter	Crude protein	Ether extract	Crude fiber	N-Free extract
Lamb No. 1	88.35	74.98	83.07	51.93	93.34
Lamb No. 2	85.20	71.40	78.97	28.42	91.16
Lamb No. 3	86.18	70.20	75.13	37.91	91.86
Lamb No. 4	88.51	81.12	84.32	38.12	92.28
Average	87.06	74.43	80.37	39.10	92.16
Well dried dent corn*		76	91	57	94

*Average of 22 trials as listed in Feeds and Feeding by Morrison.



Spraying cattle for grubs in the Hughes county control area south of Harrold, South Dakota.

HEEL FLY AND CATTLE GRUB

Control

By J. A. LOFGREN, P. H. KOHLER, J. J. O'CONNELL

LOSSES experienced by feeders, slaughterers and hide dealers, due to grubs in cattle, are passed back to the feeders and ranchers in the form of lower prices for their cattle. From the viewpoint of all concerned, it would be highly desirable to stop these losses if possible to do so.

One of the major losses apparent to the rancher results from the running or stampeding of the cattle, due to the activity of the flies when they are laying their eggs. At times, when a herd is being attacked by the flies, the cattle may tear down fences, or in an at-

tempt to evade the flies, may become mired down in water holes, sloughs, or rivers.

When the cattle feeder sees the backs of his animals bumpy with grubs and matted with pus, he wonders if the parasites are holding his stock back so that they won't gain properly. It is obvious that he would rather get cattle which have no grubs.

At the slaughter houses the trimming which is necessary on an infested carcass ruins the appearance of the loins and other choice cuts of meat, thereby reducing its value. When a

hide has more than five grub holes it is classed as grubby and brings a lower price. Holes in the hide are made by the grubs in the middle of the back which also happens to be the most valuable part of the hide to the tanner.

Rotenone Kills Grubs

We know that rotenone, when applied correctly, will kill the larvae after they have perforated the skin of the back. Up to the present time, with present methods, this seems to be the best time in the life cycle to attack the parasites. In order to know when to apply the treatments to obtain the best control, we must know the life cycles and seasonal histories of the two species of insects concerned in the problem of grub control.

Two Kinds of Cattle Grubs

There are two kinds, or species, of cattle grubs in South Dakota, the common (*Hypoderma lineatum*) and the northern (*H. bovis*). They are very similar in their habits but the common grub appears earlier under the skin of the backs of cattle than does the northern species.

The eggs of both species are laid on the hair of the cattle, usually on the lower part of the legs. The grubs hatch from the eggs in about a week as tiny maggots which burrow through the skin at the base of the hairs. Considerable time is spent by the grubs in migrating through the connective tissues of the host and at one stage they localize in the gullet (in the case of the common grub) while with the northern species, they remain in the spinal canal for a time before continuing to the back. The grubs first appear under the skin of the backs of South Dakota cattle about the end of December or the early part of January. Here they molt, or shed

their skin, for the first time and then perforate the skin of the host.

Because the grubs arrive under the skin of the backs of the cattle from January until June and remain there about a month, it is necessary to treat grubby cattle more than once. In order to kill the greatest percentage of grubs the cattle must be treated four and sometimes five times.

Rotenone Used as Spray or Dust

The safest, most effective, and generally used insecticide known to date for killing grubs is rotenone. The rotenone may be applied in several different ways; one of the most common being by power sprayer and another by hand application of the dust. The most widely used method in range country is by means of a power sprayer.

A powder containing five per cent rotenone is used at the rate of seven and one-half pounds per 100 gallons of water and applied at a pressure of at least 400 pounds per square inch at the nozzles. The nozzles should be equipped with discs having a 5/64-inch opening, or with drive discs. The spray should be coarse and driving rather than fine and mist-like. The nozzles should be held 14 to 20 inches from the skin of the animal being sprayed and in such a way so as to direct the spray almost vertically on to the skin of the animal. An area 10 to 12 inches on each side of the spine from the shoulders to the tail head should be well treated. One hundred gallons of the mixture is usually sufficient to treat about 150 head.

Another effective method of applying rotenone is in the form of a dry dust. The dust is formulated by mixing one part of five per cent rotenone with two parts of inert carrier such as

tripoli earth or pyrophyllite. There are many commercial dusts available on the market all mixed and ready for use. Most of these are labeled as containing 1.67 per cent rotenone. The dust should be applied by means of a shaker can. A suitable container may be made from a quart fruit jar fitted with a lid in which 10 or 12 one-fourth-inch holes are punched. About three ounces of the dust should be applied to an animal and rubbed in well with the finger tips with a rotary motion. Some people prefer to use a stiff bristled brush, but unless the brush is kept clean, it will become matted with hair and will not work the dust through the hair to the skin.

Area Organization Necessary to Combat Pests

One farmer or rancher may treat his cattle for grubs and reduce the grubbiness slightly, but there is usually reinfestation taking place from neighboring untreated farms and ranches. It is necessary therefore to organize an area in which all the cattle are treated to effectively combat the pests. In such areas the outer fringe of ranches may get some reinfestation from the outside, but the centrally located herds will experience a noticeable reduction in grubbiness from one year to the next.

Such areas were set up experimentally in Hughes, Haakon, Meade, Lawrence and Harding Counties. A total of about 11,500 head of cattle were involved in the whole program. They were sprayed each year in February, March, April and May.

After two years, the grub infestation in the center of the Hughes County area was reduced about 75

per cent. The reduction of infestation of the cattle located on the outer edge of this area was not as great. Much less fly activity was reported in the center of the area also. The cattle were not bothered by the flies as much as the cattle out of the control areas. These experiments indicate the need for community action in combatting cattle grubs and heel flies. It is essential that ranchers join forces and cooperate with all other ranchers in the community in an effort to control the parasites and reduce the losses caused by them.

Feed Lot Cattle Treated

There has been a need for information concerning the effect of cattle grubs on the rates of gain of feed lot cattle. In an effort to determine this effect, experimental lots of cattle were set up at the Morrell feed lots in Sioux Falls and at the college feed lots at Brookings. In these experiments, some of the cattle were treated with rotenone by spraying, dusting, and by means of the automatic currier; the others were left untreated. There were no significant differences between treated and untreated feed lot cattle in any of the tests.

The average daily rates of gain of the cattle in the Morrell feed lots for 1949 were:

Automatic currier	2.15 lbs. per day
Grubby, untreated	2.04 lbs. per day
Grubby, sprayed	2.03 lbs. per day
Low grub infestation	2.00 lbs. per day
Grubby, hand dusted	1.99 lbs. per day

(Project 163. Leaders: John A. Lofgren, Entomology-Zoology Department; Paul H. Kohler, Animal Husbandry Department; James J. O'Connell, Extension Animal Husbandman.)



Timely cultivation practices aid in controlling weeds.

Weed Control

By D. E. KRATOCHVIL, L. M. STAHLER and L. A. DERSCHIED

SOUTH DAKOTA has one of the most effective weed control programs of any state.

A program to develop practical control methods for weeds infesting agricultural land was initiated in 1945 at the Scotland Bindweed Research Farm as a cooperative project by the Agronomy department of the Experiment Station, the Bureau of Plant Industry of the USDA and the State Weed Board. The Scotland project is considered as a regional project by the United States Department of Agriculture for the development of methods of control that can be applied to areas of adjoining states as well as to the problem in South Dakota.

Investigations at the Scotland Farm cover two broad phases: (1) development of cultural control methods which include intensive cultivation, intensive cropping, and combination of the two methods and (2) the investigation and development of chemical herbicides (weed killers) and methods of application for bindweed control.

Cultivation Controls Bindweed

Intensive cultivation repeated at two week intervals may occasionally eliminate bindweed in one season but in general, two full seasons of operation are necessary. There has been no marked advantage in repeating cultivation operations at less than

10-week intervals. Wind erosion has been a definite hazard and a disadvantage in continuous cultivation operations.

Cultivation Plus Crops Effective

A combination of intensive cultivation with crops appears more practical in bindweed control than the use of intensive cultivation alone. Fall planted rye or wheat, seeded after a season of intensive cultivation, has consistently given satisfactory control of bindweed when repeated for two or three years, and has largely eliminated the hazard of soil erosion. Early planted spring barley with cultivations similar to fall planted rye and wheat has given equally good control, but has the disadvantage of risking fall and winter erosion.

An alternative practice is the use of intensive cultivation from the first emergence of the bindweed to late June and then solid planting to forage sorghum, Sudan grass, millet or soybeans, or to proso millet, as a seed crop. Sorghum or Sudan grass used in this practice over a 3-year period has given satisfactory control of bindweed, and the extensive surface root system developed by these crops during the short growing period has materially reduced the hazards of winter wind erosion.

Grasses and Legumes Help Control Bindweed

One of the most encouraging and practical investigations undertaken at the Scotland Farm is the use of perennial grass and legume forage crops as bindweed control measure. In the Scotland area, brome grass, crested wheatgrass, or alfalfa, have been outstanding in their ability to control bindweed.

2,4-D Tested Early and Extensively

At no other station in the United States has the use of 2,4-D for the control of bindweed been so thoroughly and intensively investigated. All available formulations of 2,4-D and its derivatives have been tested at various rates and dates of application, using various methods and equipment, ranging from aerosol applicators and knapsack sprayers to specially designed low-volume field sprayers.

Other herbicides have been thoroughly tested in comparison to this new material. Having established the efficiency of 2,4-D as a selective herbicide, intensive investigations were undertaken since 1947 to determine the most efficient combination of crops and cropping systems in which to use 2,4-D.

As a result, the use of 2,4-D at rates of $\frac{1}{2}$ to $\frac{3}{4}$ pounds per acre as a spray solution in 5 to 10 gallons of water per acre on bindweed in growing crops of wheat, oats or barley has become a standard practice in South Dakota and the region as a whole. This practice with a total cost for chemical and application of less than \$2.00 per acre and without any measurable effect on yield or quality of the cereal grains, has proved of great value to the entire area.

Many Weeds Tested

Recognizing the importance of other perennial weeds such as leafy spurge, Canada thistle, perennial sow-thistle, quackgrass, Russian knapweed and woody perennial species (such as buckbrush, sage and willow), and the even more extensive problems of annual weeds, research has been undertaken for the control of these pests. Investigations concerned with control of these latter species

have been largely to determine the efficiency and use of chemical herbicides.

It was recognized early that even bindweed presented a different problem in the western drier areas of the state and that control methods developed at Scotland would not apply consistently in these areas. For this reason, additional plot investigations concerned with bindweed—chemical control and competition of grass and legume crops, in particular—were established in areas not covered by the Scotland investigations.

It is worthy of note that brome-grass, which has been a star performer at the Scotland Farm, is not so well adapted in the west river area, crested wheatgrass and Russian rye grass being much more efficient in the control of bindweed under conditions of lower available moisture. The use of 2,4-D for control of bindweed in the areas of lower moisture has resulted in less consistent and less efficient control than under conditions experienced at the Scotland Farm. This is a problem that is receiving more and more attention from the research personnel of the weed project.

Annual Weeds Controlled by 2,4-D

Research investigations in South Dakota have played an important part in the development of use of 2,4-D as a selective herbicide for the control of annual weeds in growing crops of wheat, oats, barley, flax, corn and sorghum. As a result of the investigations in South Dakota and coordinated and cooperative trials undertaken in the adjoining states of Minnesota and North Dakota, field spraying and equipment were radically revised

and improved. In 1946 standard recommendations for application of herbicides, such as 2,4-D, called for 80 gallons of spray solution per acre as a minimum—in 1948 our recommendations had been revised to include 5 to 10 gallons spray solution per acre as a standard application.

When we consider that the use of from one-fourth to one-half pound of 2,4-D per acre applied in 5 to 10 gallons of water per acre, or 1 to 2 gallons of oil per acre, was undertaken on approximately 3 million acres of growing crops in South Dakota this past season—which ranks it first among the 48 states in acres sprayed with 2,4-D—the effect that these developments have had on our agricultural practices is well evident. Throughout these investigations and developments the possible effect of 2,4-D on yield, quality, germination and genetic make-up of crop plants has not been overlooked.

Recommendations for Field Use

Results of weed control investigations conducted at the South Dakota Agricultural Experiment Station and recommendations for field use of weed control practices derived from these data are available in circulars and bulletins. These publications are revised each year to conform with latest findings and developments in this rapidly growing and ever changing field of agricultural research. These current publications may be secured, through the office of your local county agricultural agent, or Agricultural Experiment Station, S. D. State College, Brookings, South Dakota. (Project 32, Agronomy Department.)

By J. E. GRAFIUS and V. A. DIRKS

A NEW OAT like a new car is expected to have some improvements over the old model. After becoming the proud owner of a new car we begin to discover some of the faults as well as the advertised virtues. The purpose of this article is to give the background of the development of James hullless oats and to acquaint the farmer with its good and bad points. James is a mid-early, stiff-strawed, hullless oat, with resistance to stem rust, leaf rust and smut.

Hullless oats are desirable as feed for swine and poultry. Varieties of hullless oats have been known for many years, but because of susceptibility to smut, none of them gained favor with the farmers of this area. Recognizing the problem, Mathew Fowlds, a member of the Agronomy department of South Dakota State College, produced, after a decade and a half of work, a smut resistant variety of oats from the cross of (Markton-Richland) x (Swedish Select-Kilby Hullless). This variety was named Nakota. It produced an excellent yield, but—like all varieties, had its weakness.

JAMES *Hullless* OATS

Nakota was released in 1935. It had been produced and tested under the dry conditions of the 30's, when leaf rust was not a problem. In 1941, with



the advent of higher rainfall and greater relative humidity, leaf rust became a major problem in oat production in eastern South Dakota. Nakota proved to be extremely susceptible. Reluctantly, the farmers dropped the hulless variety in favor of new varieties of common oats that were resistant to leaf rust.

Breeding for New Rust Resistant Oat Started

If common varieties of oats could be made resistant to leaf rust by hybridization, then a hulless variety could also be made resistant. Two sources of resistance to leaf rust were known—Bond and Victoria. A cross was made between Nakota and a Bond derivative and the breeding program was initiated. However, it was learned that Dr. H. C. Murphy, USDA pathologist, had bulk third generation material of a similar cross, Nakota x (Double cross-Bond). Requests were made for this material and seed was obtained in the spring of 1942. This generosity on the part of Dr. Murphy and the Iowa Agricultural Experiment Station advanced the release of a new rust and smut resistant hulless oat for South Dakota by three years.

It was fortunate that the seed obtained from Dr. Murphy was an unselected bulk lot. This meant that a large number of different types existed in the population and that after the F_5 (the fifth generation of selfing) many true breeding types could be selected. Plant selections were made in 1943.

In 1944 the seed from about 2,000 plants were seeded in the individual 5-foot rows and rigorously culled during the season. Only true-breeding hulless types that were early, stiff-strawed

and resistant to leaf rust were saved. At the end of the season, only 100 rows were marked to be saved. These 100 rows were further eliminated by yield tests in replicated rod-row plots in 1945. Sufficient seed was available by 1946 to test the remaining lines for yield in rod-row plots at the field stations at Highmore, Eureka and Cottonwood as well as at the main experiment station at Brookings.

In the winter of 1946-47, eight of the superior lines were tested for smut reaction. In this same year increases were started of two of the remaining adapted, hulless types that were resistant to leaf rust, stem rust and to all known races of smut. Subsequent statewide performance testing narrowed the field to one variety which was named James.

New Oat Early and Leaf Rust Resistant

Seed and plant characteristics of James can be described best by comparing it with the varieties shown in Table 1.

In comparison with Nakota, James shows an improvement in earliness, lodging resistance, leaf rust resistance and test weight. The increase in test weight is largely due to increase in leaf rust resistance. It should be pointed out that James, like Clinton and Mindo, is susceptible to Race 45 of leaf rust and Races 3 and 7 of stem rust. While no good tests on shattering are available, field observations indicate that it is equal to Nakota which was satisfactory in this respect.

Yields Are High

In calculating the yields of hulless oats (Table 2) it is necessary to adjust for hulls in order that the data may be comparable to that from common

Table 1. Average plant and seed characteristics of James, Clinton Vikota, Mindo, and Nakota, grown at Brookings, 1946-49.

Variety	Date headed	Lodging resistance	Height inches	Test* weight lbs./bu.	Stem rust resistance	Leaf rust resistance	Helminthosporium victoriae resistance
James	6/18	R†	33	45.0	MR	MR	R
Clinton	6/18	R	32	36.8	MR	MR	R
Vikota	6/18	MS	30	33.5	MR	R	S
Mindo	6/15	R	30	36.4	MR	MR	R
Nakota	6/20	MS	34	40.9	MR	S	R

*The legal test weight for hullless oats is 42 pounds per measured bushel.

†R—resistant, S—susceptible, MR—moderately resistant, MS—moderately susceptible.

Table 2. Yield comparisons in bushels per acre of James with four standard varieties at four locations in South Dakota.

Variety	Brookings 1946-49	Highmore 1947-49	Cottonwood 1947-49	Eureka 1948-49
James*	82.0	74.8	36.6	30.5
Clinton	75.4	64.4	31.4	30.0
Vikota	63.5	70.5	37.1	31.4
Mindo	72.4	69.0	38.8	31.0
Nakota*	68.2	—	—	—
Least significant difference	5.1	5.6	5.0	4.5

*Hulless, adjusted for hulls by dividing by 0.7.

oats. This adjustment was made on the assumption that approximately 0.3 of the weight of common oats was due to the hull and that the remaining 0.7 was due to the groat.

The average yields of James, when adjusted for hulls, compare favorably with the yields of the standard varieties, and at Brookings the 4-year average for James exceeds all others by a statistically significant difference. This variety is best suited to eastern South Dakota and should be restricted west of the Missouri river to small acreages for a special purpose crop and to areas in the Black Hills.

Cultural Practices in South Dakota

James oats should be seeded at the rate of 50 pounds per acre.

No special equipment is needed for harvesting. James may be cut with a binder, windrowed, or direct combined in accordance with the best practices for common oats in the par-

ticular area. Hulless oats should not be cut green as this will cause the oats to be light weight and hard to thresh.

For feed purposes no special cleaning is necessary. For seed purposes, it is best to scalp with a fanning mill and then use a Carter disk.

Storage under South Dakota conditions presents no serious problem as hulless oats that have a moisture content of 13 percent or less have been found to store well.

Information on Release

About 2,000 bushels of James will be released to the County Crop Improvement Associations in the spring of 1950. The seed is limited and no direct sales to individuals will be made. Limited quantities will be available in 1951 for individual farmers through purchases of seed from the County Crop Improvement Associations. (Project 25 and 181. Leader: V.A. Dirks, Agronomy Department.)

REMOVAL of most of the comb and wattles of the chicken is known as dubbing. Cockerels, which are to be saved for breeding males, are quite commonly dubbed in many sections of the United States. The practice has been found beneficial in prevention of freezing damage even in sections having milder winters than South Dakota.

Because dubbed males are less likely to be affected by low temperatures and less subject to injury from fighting, they commonly give higher fertility than normal males. There has been no information available on the effects of dubbing females in a climate where winters are as cold as those of South Dakota.

White Leghorn Pullets Used

To obtain information on the effect of dubbing females, two pens of normal and two pens of dubbed White Leghorn pullets were housed at the North Central substation at Eu-

reka. These birds were compared in respect to egg production and mortality from November 1, 1947, to September 14, 1948. The experiment was repeated with a similar group of pullets from October 1, 1948, to September 21, 1949.

Leghorns were chosen for this work because the mature females usually have a large comb and wattles. If freezing damage does occur due to low temperatures it is reasonable to expect that it would be more severe in females with large combs than in those with small combs such as those commonly found in New Hampshires or White Plymouth Rocks. To insure as nearly complete removal of the comb and wattles as possible, the dubbing was postponed until the pullets were nearly sexually mature. The pullet illustrated shows the completeness of comb and wattle removal.

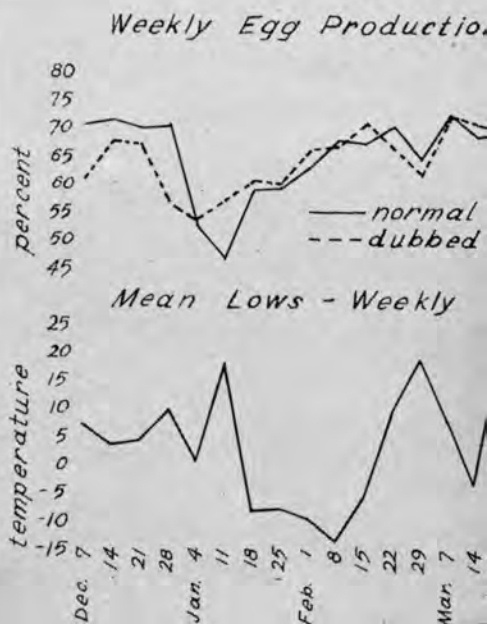
The laying house was of rammed-

DUBBED HENS LAY

Normal White Leghorn pullet



1947-48
Graph 1. Percentage egg production and mean low temp



earth construction. All pens received a free-choice grain and mash laying ration with water and oyster shells. In these and other details of management, their care was not greatly different than that of the average well-fed South Dakota farm flock. Daily records were kept of egg production and mortality for each pen. To eliminate the effects of differential mortality in the various pens, percentage egg production was calculated on a hen-day basis.

Dubbing Operation Not Serious

Although the dubbing operation causes some loss of blood, it is not a serious operation since no deaths occurred as a result of dubbing in either year. The dubbed pullets were slightly slower in coming into production which is probably a direct result of dubbing the birds when they are nearly sexually mature. This delay could perhaps be avoided by dubbing ear-

lier, but earlier dubbing would not permit such close trimming.

The effect of cold weather on egg production in the two groups is clearly revealed by the graphs. Graph 1 shows the percentage egg production for weekly periods from December 1, 1947, to March 29, 1948. The mean low temperatures for the weekly periods are plotted on the lower part of the graph. Graph 2 gives the same data for the corresponding period in 1948-49. Inspection of the graphs will reveal that there is a lag of about one week between a drop in temperature and a drop in egg production.

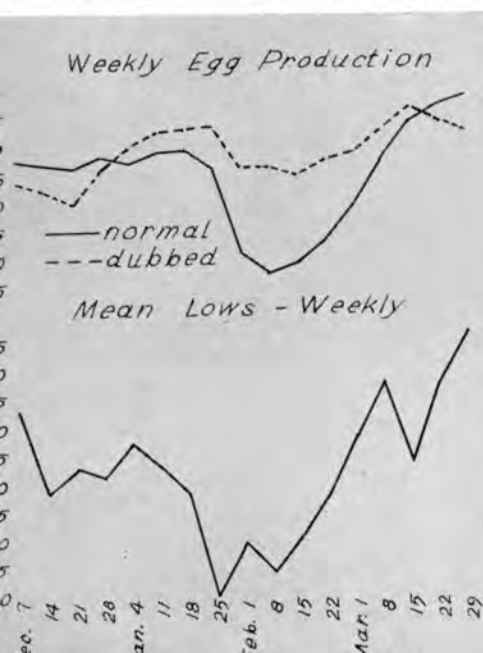
An interesting and rather surprising result was that an early season cold snap depresses egg production, but later on in the winter the birds may actually be increasing in egg production at temperatures considerably below those recorded at the earlier period. This is an excellent example

MORE WINTER EGGS

1948-49

Percentage egg production and mean low temperatures

Dubbed White Leghorn pullet



of physiological adjustment to cold.

Egg Production Increases

During the winter of 1947-48, there was little difference between the dubbed and normal birds in egg production with the exception of a one-week period. However, during the winter of 1948-49 the dubbed birds laid better than the normal birds during most of the period. The response of the birds in the two groups to changes in temperature are quite similar, but in 1948-49 the dubbed birds were much less seriously affected than were the normal birds. As might be expected from the appearance of the graphs, a statistical analysis reveals there is a significant difference in egg production of normal and dubbed fe-

males in 1948-49, but no difference in 1947-48.

The explanation for the difference in the two years would seem to be found in the fact that the winter of 1948-49 was more severe than that of 1947-48. During 1948-49 the mean low temperatures were lower and they lasted for a longer period.

It is evident that in some years South Dakota farmers might expect to get more winter eggs from dubbed White Leghorn pullets than from normal ones. Almost identical numbers of birds died in the dubbed pens as in the normal pens so it is evident that dubbing does not influence mortality. Likewise, on the basis of yearly egg production there was no difference between the normal and dubbed birds. (Project 194. Poultry Dept.)



FOWL CHOLERA



J. B. TAYLOR and G. S. HARSHFIELD

LOSSES from fowl cholera are seen every month of the year, but outbreaks are much more prevalent during the fall months. The most logical explanation of this seasonal prevalence is the exposure given to young birds brought in contact with older birds in housing in the fall. "Healthy carriers," (apparently normal birds which carry the fowl cholera organism in their respiratory passages) are known to be present in flocks.

Since carrier birds are often the source of infection for new outbreaks, it would be desirable if they could be identified and culled from the flocks. A test similar to the rapid, whole blood stained antigen test for pullorum disease has been used in flocks where fowl cholera has occurred. This test has identified a few of the carriers, but has not been accurate enough.

Various sulfa drugs have been tried in experimental birds and in farm flocks to check the death loss that accompanies acute outbreaks. Sulfathiazole, sulfaquinoxaline and sulfamethazine have proved effective in checking the losses from death during the period that the drugs were supplied. Often, however, additional deaths occurred after the sulfa drugs were discontinued. Where fowl cholera infection existed in flocks as a chronic disease, control of death loss has not been satisfactory with these agents.

Sanitation measures should include frequent removal of sick and dead birds, thorough cleaning of the poultry house and the feeding and watering equipment. The cleaning operations should be carried out during the period that the drugs are supplied to the flock. (Project No. 141. Veterinary Department.)



Tomatoes...



SOUTH DAKOTA HYBRID NO. 2

By S. A. McCrory

HOME GARDENERS will like the South Dakota hybrid No. 2, a solid, meaty tomato of a size that is ideal for canning. It is a medium small fruit, about two inches in diameter, and will fit nicely into home fruit jars without cutting. Its smooth surface, free of cracks, make it very attractive. Also one of the earliest tomatoes, it yields a high percentage of marketable fruits with very few culls.

The desirability of growing a well-adapted hybrid tomato is now well known to people who have planted South Dakota No. 2. After undergoing testing for three years at various locations in the state, this hybrid has demonstrated its ability to produce early fruit as well as a high total yield.

Performance tests were conducted at Brookings, Yankton and Redfield in 1949. Cut worm loss, hail damage and drought reduced yields materially, and early frost shortened the picking season at Redfield and Brookings. It is not our intent to show differences in yield at the different locations, but

to rank the various hybrids in different sections of the state.

The yields given in Table 1 are expressed in tons per acre. However, it should be kept in mind that this experiment was disturbed by the causes mentioned. Results are based on three randomized replications of 12 plants each with a spacing of 4 by 5 feet.

Cost of Hybrid Tomato Seed Justified

Getting enough seed of this hybrid has presented a problem. Some experimental work conducted during the past two years by the Horticulture department has indicated that this is a time-consuming and rather expensive operation.

Crosses were originally made from greenhouse-grown plantings. This operation consists of planting the pistillate plant, (the one producing the fruit) and in a nearby location planting one pollen-producing plant for every ten pistillate plants. As the flowers develop, the crossing technique requires timely visits to remove any of the pollen-bearing part of the blossom

Table 1. Tons per Acre Yield at the Following Locations

Variety	Brookings	Yankton	Redfield
Chatham	3.58	3.17	3.00
Earliana	1.01	3.82	2.83
Firesteel	4.11	4.78	3.67
Long Red	1.82	3.39	1.23
Sioux	2.97	9.56	1.34
Stokesdale	1.09	6.87	1.72
Victor	3.38	7.82	(3)3.84
Main Crop	1.00	2.30	.81
Early Crop	2.40	5.51	
South Dakota No. 2	(1)*4.49	(3)11.26	(1)5.23
Stokes Crop No. 5	1.83	4.73	.83
South Dakota No. 23	(2)4.44	(2)11.85	2.57
Red Rival F	1.14	6.80	
Red Knight	3.75	7.95	
South Dakota No. 3	(3)4.21	(1)13.18	(2)3.92
South Dakota No. 21	3.97	10.91	3.32
N. D. No. 49			3.06
M. D. X-A F ₄			1.71
L. B. R. 104 F ₆			2.89

*Numbers in parentheses denote rank for yields.

before there is danger of its fertilization. The following day the cross is made by a hand operation. Immature blossoms or any that may have fertilized themselves are removed and a tag carrying the date and record of cross is then attached to the flower cluster. This same technique is necessary for plants growing in the field.

The number of seed obtained in the greenhouse and under field conditions did not differ materially. Approximately one seed per gram of fruit, or 450 seeds per pound, were obtained. For a variety such as South Dakota Hybrid No. 2, four different flower clusters can be crossed during a growing season.

Since not all the blossoms develop uniformly, an average of two fruits per cluster is a fair number to use for crossing. These will generally run about four to the pound, or two pounds of fruit per plant. There are approximately 10,000 seeds per ounce for this hybrid, or 160,000 seeds per pound. At the above mentioned rate, 350 pounds of fruit will be required

to produce about one pound of seed.

A spacing of 3 by 4 feet is a desirable distance for a planting when the plants are grown with the aid of stake supports. At this spacing, a planting large enough to produce a pound of seed would occupy approximately one-twentieth of an acre. An additional space would be needed for the pollen-producing plants.

The number of man hours labor required to care for such a planting will vary depending upon the type of labor available, so that figures are difficult to quote. For example, girls of high school age who did much of this work improved their skill materially after a few weeks of work. A planting of one-half acre would need two workers for the first cluster with additional helpers the following week until five or six would be needed at the peak of the growing season.

It is not practical to make crosses later than the 20th of August in the Brookings area, since we may expect frost by September 25. (Project 49. Horticulture Department.)



By H. C. SEVERIN

years have been very influential in keeping down grasshoppers in South Dakota and have undoubtedly affected the grasshopper expectancy for 1950. Grasshopper infestations in South Dakota for 1950 are expected to be about the same as during 1949.

Where to Find Egg Beds

One hundred and fifteen different kinds of grasshoppers live within the borders of South Dakota, but usually only five of these become injurious to crops.

The differential and two-striped grasshoppers prefer to lay their eggs in grassy areas—roadsides, ditch banks, grassy borders of grain fields, weedy idle land, and grassy borders of corn and sorghum fields. Eggs may also be laid in grassy borders of alfalfa fields or even throughout alfalfa fields

'HOPPERS

1950

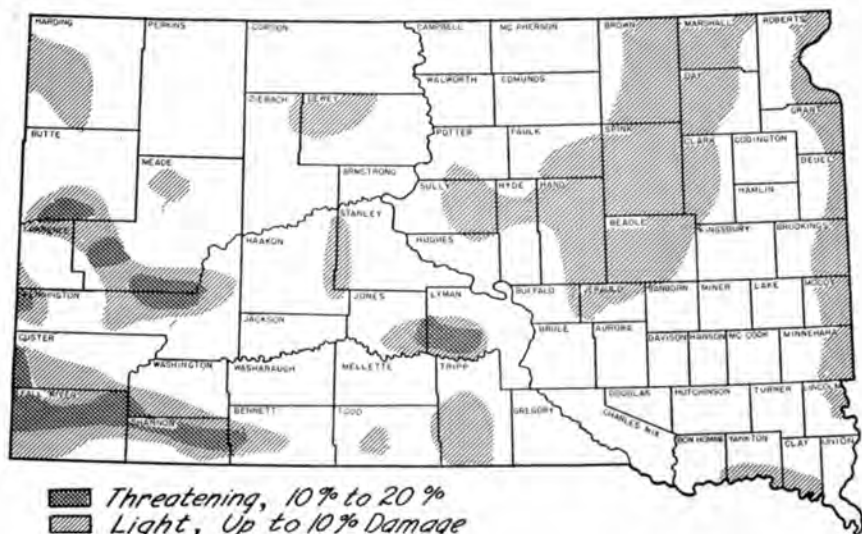
FOR THE 5-YEAR PERIOD, 1937 to 1941, it is estimated that in South Dakota alone, grasshoppers caused a loss of \$43,203,000 to the growers of cereal, forage and truck crops. Grasshoppers vary in abundance in South Dakota over a long series of years, occurring in outbreak numbers over large areas during some years and doing an immense amount of damage, and in other years occurring in negligible numbers in some of these same areas. This much is certain, however, grasshoppers occur in damaging numbers somewhere in the state every year.

Control measures practiced by farmers and ranchers in the past ten

if the stand of alfalfa is poor. The lesser migratory grasshopper often lays most of its eggs amongst the roots of grain stubble, but some may also be laid in grassy headlands, fence rows, pastures, and similar locations.

Methods of Controlling

The use of early maturing varieties of grains is especially important during years when grasshopper outbreaks are forecast, for this may spell the difference between a good harvest or a very poor one. The Agronomy depart-



The 1950 grasshopper outlook. The situation can change with the weather. Map prepared by U. S. Bureau of Entomology and Plant Quarantine in cooperation with the State College Extension Service

ment of South Dakota State College, the Extension service agronomist, or the county agent are in a position to offer sound advice on this matter.

Using resistant varieties and substituting sorghum for corn are highly desirable practices to follow in areas where a severe grasshopper outbreak is forecast. Here again, advice should be sought from the agencies mentioned.

Poisons in baits, sprays and dusts have been used successfully for killing grasshoppers for some time. Since chlordan and toxaphene have become available, these poisons have supplanted to a large extent all other poisons, to date, in South Dakota and most other states.

Killing Young Hoppers Gives Best Results

When poisons are used it should be remembered that it is a much easier job to kill the young hoppers than it is to kill mature grasshoppers. Often-

times it is possible to kill young hoppers on their hatching beds, and since such beds are frequently localized in the borders of grain fields or along roadways rather than in grain fields, it means considerable saving of time, labor and materials if the hoppers are destroyed before they invade a cultivated field. In addition, if this is done, all damage to crops will be avoided. Should grasshoppers hatch throughout a field, then the only recourse is to treat the entire field. Baits can best be applied through bait spreaders. Sprays and dusts may best be applied through power sprayers, dusters or by planes.

Chlordan

Sprays—In general, 1 pound of technical chlordan should be used per acre. Young hoppers can be killed with three-fourths pound chlordan per acre, but for longer residual effect and for older nymphs, 1 pound per acre should be used. For adults, and

when vegetation is sparse and dry, 1½ pounds of chlordan may be desirable.

Dusts—When chlordan is applied as a dust, some of it is lost because of wind drift. As a consequence, increase the dosage by one-fourth pound in each of the recommendations mentioned.

Baits—Chlordan may be substituted for sodium fluosilicate in preparing baits. These baits may be prepared in either a wet or dry formulation, according to the directions of the United States Bureau of Entomology and Plant Quarantine.¹

Toxaphene

Sprays—In general, 1½ pounds of technical toxaphene should be used per acre. Young hoppers can be killed with 1 pound of toxaphene per acre, but for longer residual effect and for older nymphs, 1½ pounds of toxaphene should be used. For adults, and

when vegetation is sparse and dry, 2 pounds of toxaphene per acre may be desirable.

Dusts—When toxaphene is applied as a dust, some of it is lost because of wind drift. As a consequence, increase the dosage by one-half pound for each of the recommendations mentioned.

Baits—Toxaphene may be substituted for sodium fluosilicate in preparing baits. These baits may be prepared in either a wet or dry formulation, according to the directions of the United States Bureau of Entomology and Plant Quarantine.¹

CAUTION: Remember that chlordan and toxaphene, like most other insecticides, are poisonous. Precautions should be taken in handling them and in feeding recently sprayed forage to livestock. Alfalfa recently sprayed with chlordan or toxaphene should not be fed to milk cows or to beef cattle that are to be slaughtered in a short time. (Project 18, Entomology Department.)

¹Wakeland, Claude and Parker, J. R. *Grasshopper Control Improved by New Insecticides*, U. S. Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Ec-7, February 1949.

Showing the devastation to a corn field which can result from a severe grasshopper outbreak.





South Dakota's **VITAMIN C** **FRUIT**

By S. A. McCrory

STRAWBERRIES are the one fruit grown in South Dakota which equals citrus fruit in vitamin C content. A 3½-ounce serving, or approximately one-sixth of a quart of strawberries, is generally considered adequate for the daily requirement of vitamin C.

However, in observations made at the Experiment Station, much variation in vitamin C content was found between different varieties. In general, those that produce fruit on long stems are higher in vitamin C content than those that bear fruit on short stems. Fruit exposed to the direct rays of the sun is higher in vitamin C content than that shaded by the leaves of the plant. Also, fruit harvested on clear days contains a higher vitamin C content than fruit harvested during cloudy weather. Everbearing varieties

produced fruit containing as much as 20 percent more vitamin C in the June crop than was found in ripe fruit in late September. This evidence is further proof that light is a very important factor in producing strawberries of good quality and with a high vitamin C content.

Eight commonly grown varieties of strawberries were observed and are ranked in Table 1 according to their vitamin C content.

Table 1. Ascorbic Acid Content of Strawberry Varieties

Variety	Mg. Vit. C/100 Grams
Fairfax	66.20
Burgundy	65.43
Mastodon	64.52
Dunlap	63.95
Premier	56.31
Gem	55.67
Aberdeen	49.10
Pathfinder	49.10

Table 2. Ascorbic Acid Content of Fruit Exposed to Direct Sun and Fruit Shaded by Leaves

Variety	Mg. Vit. C/100 Grams	
	Exposed to sun	Shaded by leaves
Burgundy	66.26	64.60
Dunlap	65.38	62.53
Aberdeen	53.98	44.23
Gem	64.96	46.39
Mastodon	65.48	63.57
Fairfax	66.76	65.64

It was decided to sample fruit exposed to the direct rays of the sun, and, from the same plants, select fruit shaded by leaves. Six varieties were used in this study and are described in Table 2.

With the exception of Aberdeen, there is little difference between varie-

June crop, which is quite in keeping with the idea that light is directly responsible for synthesis of Vitamin C.

The fall crop of everbearing strawberries is generally highly prized by the grower. Usually the peak of the yield for the fall crop at this location comes in late September. The vitamin

Table 3. Ascorbic Acid Content of Fruit Harvested on Clear and Cloudy Days

Variety	Mg. Vit. C/100 Grams			
	Cloudy day		Clear day	
	Exposed	Shade	Exposed	Shade
Gem	59.73	53.7	65.35	47.37
Fairfax	62.56	61.75	66.76	65.64
Burgundy	59.94	59.32	68.86	65.64

Strawberries

ties in vitamin C content when the fruit is exposed to the direct rays of the sun. The Aberdeen variety is a poorly colored fruit and was not found to contain much vitamin C.

It is well known that strawberries harvested during cloudy weather are of poor quality. To measure the influence of cloudy weather on vitamin C content, strawberries were sampled on clear and cloudy days. The fruit taken from an exposed position, as well as that taken from under the leaves, shows a higher vitamin C content on clear days than during cloudy weather. This would certainly indicate that, for high quality fruit, exposure to full sunlight is necessary.

The value of everbearing strawberries has sometimes been questioned. In the Gem and Mastodon varieties the vitamin C content is materially lower with the fall crop than with the

C content of fruit collected on June 10 and on September 25, from comparable plants of Gem and Mastodon varieties, is much greater in June, as shown in Table 4.

To make practical applications of this it seems that, with everything else equal, it would be advisable to select varieties of strawberries producing fruit on a long fruit stem. Locate the planting in full sunlight, space the plant so as to avoid a crowded condition, and see that no weed growth shades it. (Project 145. Horticulture Department.)

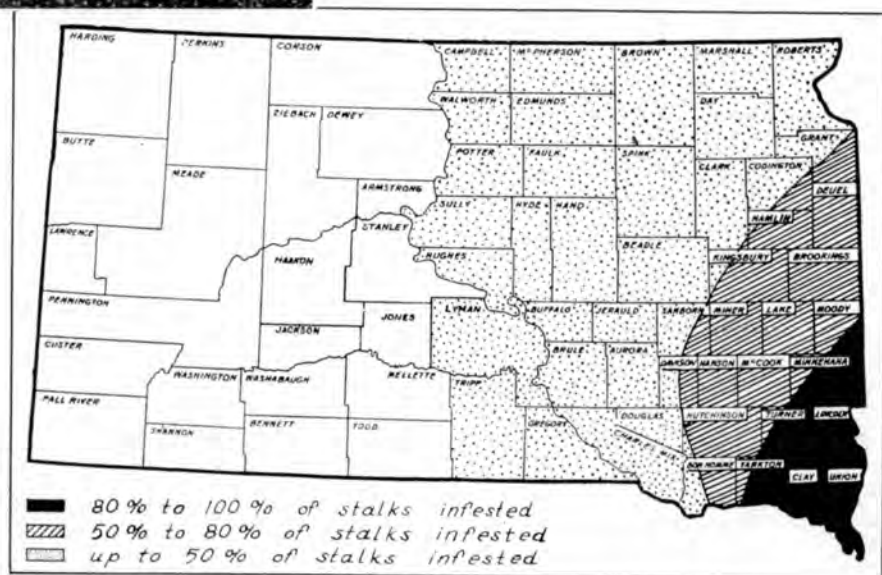
Table 4. Comparison of Spring and Fall Crops of Everbearing Strawberries

Variety	Mg. Vit. C/100 Grams	
	June 10	Sept. 25
Gem	55.67	45.52
Mastodon	64.52	43.71



Controlling THE EUROPEAN CORN BORER

By GERALD B. SPAWN



THE EUROPEAN CORN BORER is at present South Dakota's No. 1 corn pest. Although having only recently established residence here (it was found in South Dakota for the first time in the summer of 1946) the borer has now made its unwelcome presence felt in the entire eastern half of the state. With favorable weather conditions for its development this

pest has increased in numbers and has spread rapidly during the four years it has been with us.

During the past two years the South Dakota State College Experiment Station has conducted fall corn borer abundance surveys. The survey figures were submitted to the U. S. Bureau of Entomology and Plant Quarantine for comparison with those

of other states. On the basis of these figures the Bureau estimated that in South Dakota in 1948 the corn borer caused a loss of \$2,436,000 in field corn harvested for grain. In 1949 this loss figure was placed at \$7,545,000.

Since South Dakota has had the corn borer for such a short period of time, the Experiment Station recommendations for control must necessarily be quite largely those of other states, revised for use under our climatic and soil conditions. We cannot expect to obtain 100 percent control of the corn borer in field corn by any single control measure. However, a very large proportion of the loss can be prevented by the use of a combination of different control methods.

Field Sanitation Is Important

The Experiment Station recommends that stalks be plowed under in the spring, if the plowing can be completed by May 10 to 15. If this practice is to provide the utmost benefit to the farmer it must be done throughout a wide area, preferably a state-wide program, since the corn borer moths can fly as far as fifty miles.

The Station does not recommend fall plowing-under of corn stalk re-

mains in South Dakota. Entire fields, plowed in the fall, produce a soil-blowing erosion hazard which is not believed to be justified from the standpoint of borer control.

Burning of corn stalks is *not* recommended. Our soil needs the humus provided by the stalk residue, not only to assist in maintaining soil fertility, but also for keeping the soil mellow, for providing aeration, for holding the necessary moisture and for the prevention of erosion.

Planting Dates

The earliest and the latest planted fields in a community usually suffer the heaviest infestations of borers. Midseason-planted fields usually have the lightest infestations. These dates obviously will vary with years and will also be different in the northern and southern parts of the state. Where planting can be delayed to the middle of the planting season such a procedure is recommended. However, the farmer is cautioned to consider the number of growing days needed to bring his varieties of corn to maturity.

Parasite Introduced

A small, wasp-like parasite (*Chelonus annulipes*) has been introduced into the state. If it becomes established it will be merely an aid in control of the borer; it will *not* solve the borer problem.

Sprays or Dusts Give Satisfactory Results

Chemical control is the recommended emergency control measure against corn borers in field corn, using either sprays or dusts of DDT.

(Top left) An egg mass, showing the black-head stage. (Center left) Known distribution of European corn borer in South Dakota, Fall 1949. (Left) Newly-hatched borers on corn leaf. Photos courtesy of USDA Extension Service.



The need for the use of insecticides should be based upon the farmer's own survey of his fields at the time the corn borer moths are laying their eggs. The Station plans to carry on a service to the farmers wherein the farmers will be advised, by radio, newspaper releases, and through county extension agents, of the developmental progress of the borers. If there are as many as 50 or more egg masses per 100 plants in corn when it is not less than 35 inches high with leaves fully extended upward, then insecticidal controls will pay.

In such cases either a two-treatment or one-treatment method is recommended, depending upon the severity of the infestation and degree of control desired. If the two-treatment plan is used then the first application should be made about seven days after the first eggs hatch. The second application of insecticide should follow one week after the first. If only one treatment is to be given, then spraying or dusting should be done 10 to 12 days after the first eggs hatch.

Recommendations

The use of 1½ pounds of technical DDT per acre is recommended for sprays, while with dusts 2 pounds of technical DDT per acre are suggested. The amount of stock insecticide to be used will depend upon the percentage of DDT in the stock. Use just enough to give the required amount of technical DDT per acre, and in the case of emulsion concentrates use only such emulsions as have been found safe for application to growing corn. Xylene base concentrates have produced no burning of leaves if used properly.

Where emulsion concentrates are used the stock material should be added to five to ten gallons of water

per acre. Emulsion concentrate stock is recommended for use in all ground sprayers which do not have mechanical agitators in the tank. If the tank has a mechanical agitator then DDT wettable powders may be used, and not less than 15 gallons of finished spray should be applied per acre.

For aircraft application the emulsion concentrate stock is recommended, in from 2 to 5 gallons of water per acre. Concentrated oil solutions of DDT used as such are *not* recommended. DDT and Ryania (a South American plant), are both satisfactory for use as dusts.

Of these insecticides DDT is less expensive and much more readily available at present. The 10 percent DDT dust should be applied at the rate of 20 pounds per acre; 5 percent DDT dust, at 40 pounds per acre. These rates of application will give the required 2 pounds of technical DDT per acre. Row crop dusters with two or more nozzles per row are suitable for use in control of corn borers. Ground dusters providing high air velocity and volume are more satisfactory than are dusters with low velocity and volume. If aircraft are used for dusting, the flight height should not be greater than six feet from corn tops to wheels.

The above recommendations apply to first generation borers. The control of second generation borers in field corn is not ordinarily recommended because of difficulty of application. However, in fields with heavy infestations (100 or more egg masses per 100 plants) the control of second generation borers, for prevention of stalk breakage and ear dropping, will be profitable. Because of the height of the corn at the time the second brood borers appear, control applications of

sprays and dusts for this brood can be made only by use of aircraft or by sprayers and dusters mounted on detasseling machines.

Recommendations for Canning Corn

South Dakota does not at present produce large acreages of sweet corn for canning purposes; however, a restricted area in the extreme northeastern part of the state does produce some.

In the examination of sweet corn plants for deposits of egg masses the farmer should start making inspections of his fields when the plants reach an extended leaf height of 25 inches. Fields should be examined at 4-day intervals until egg deposition is completed. Attention should be given the undersides of the lower leaves.

If the inspection shows 20 or more egg masses per 100 plants on varieties with maturities of 75 days or less, or 50 or more masses on varieties with maturities of more than 75 days, then spraying or dusting is recommended. During very early seasons, late-maturing varieties may be so advanced in growth that treatment will be warranted at egg mass levels of less than 50 per 100 plants.

When to Apply Insecticides

In timing application of insecticides on canning corn, make the first application on early maturing varieties when there are 20 or more egg masses per 100 plants and one or more of the egg masses shows signs of hatching (the black-head stage). On late maturing varieties, make the first application seven days after the first evidence of hatching.

The need for treatment against second brood borers in canning corn is based upon two conditions in general:

(a) If inspection of plants shows 20

or more egg masses per 100 plants, (b) If planting will not be harvested during the succeeding twelve days.

The grower should start examining plants for egg masses for second generation borers when examination of first-generation tunnels, in earlier planted fields, shows that moths have emerged, *or* when moth flight has been observed, *or* when advised to do so by state and local agricultural agencies. Examinations should be made at 3 to 4 day intervals, with particular attention being paid to flag-leaves, husks and undersides of true leaves. First application of insecticides should be made when the first black-head or hatched egg mass is observed. Treatments should be continued at 5-day intervals as long as there are 20 or more unhatched egg masses per 100 plants, or until 12 days in advance of harvest. Special conditions might make it necessary to deviate slightly from this schedule.

Observe Cautions

DDT treated fields should not be pastured following harvest; neither should stalks or husks be used for fodder or silage. Small amounts of DDT (a cumulative poison) may be excreted in milk or deposited in fat of animals being finished for slaughter.

If Ryania is used, then stalks, etc., may be used for feed, since experiments from other states indicate that Ryania when properly used in borer control does not harm animals even if they eat recently treated plants. Also it does not accumulate in milk or animal fat.

More detailed suggestions on corn borer control are available through the South Dakota Experiment Station, State College, Brookings. (FBJ Project 187, Entomology Dept.)

Newcastle Disease

BY G. S. HARSHFIELD

A NEW, HIGHLY CONTAGIOUS poultry disease made its first appearance in 1946. This disease, named Newcastle, has been a cause of serious outbreaks in several European and Asiatic countries for over 20 years. A disease called pneumo-encephalitis which later proved to be the same as Newcastle disease, was recognized in California in the period from 1935 to 1940. In 1945, Newcastle disease was found in New Jersey and it has since spread into all of the states and also into Canada and Mexico.

Nature of Disease

Newcastle disease may affect birds of all ages. In young chicks the first symptoms are usually gasping, coughing, rattling and difficult breathing. In these respects the symptoms resemble those of other respiratory diseases. Within two or three days some of the chicks may develop symptoms indicating nervous disorder. These symptoms vary. Partial or complete leg paralysis, tremors, circling or walking

backwards, and twisting of the head and neck are the more common ones.

In older birds the same symptoms occur, but may be so slight as to escape notice by the caretaker. The most common and significant feature of the disease in laying flocks is the sudden and almost total drop in egg production within a period of three or four days. Floor eggs, soft shells or irregularly-shaped eggs are common during the drop in production. It usually requires three or four weeks before any material return of production is evident.

Death losses in outbreaks vary over a wide range. In general, losses are higher in chicks than in adult birds. We have had outbreaks in chicks in South Dakota in which over 80 percent died, but an average for this age is nearer 40 percent. On the other hand, some outbreaks in laying flocks occur with not over one or two percent of the birds dying. The average death loss in mature birds is 10 to 15

percent. All birds in a flock become infected in an outbreak whether symptoms are observed or not.

Other fowls are susceptible. Turkeys may show symptoms similar to those observed in chickens. Geese and ducks are less susceptible. Outbreaks have occurred in pheasants in captivity. We have tested blood from 70 wild pheasants and found evidence of some previous exposure to the disease virus in two.

There are several reports of people becoming infected by contact with infected fowls, either live or dressed. In

humans, it results in an irritating eye infection lasting for a few days.

Technical Skill Needed to Make Diagnosis

Sometimes, when symptoms are typical, a tentative diagnosis can be made by observing the flock. Since nervous and respiratory symptoms are also associated with other poultry diseases such as fowl cholera, laryngotracheitis, and infectious bronchitis, laboratory examination and specific tests are necessary for positive diagnosis.

Lack of coordination of the muscles in Newcastle disease, manifested by twisting of the head.



The laboratory of the Veterinary department has been using specific tests for the diagnosis of Newcastle disease since 1946. We have found Newcastle disease in 36 counties since it first appeared in the state and it is most probable that outbreaks have occurred in many of the remaining counties.

Year	Outbreaks	No. of counties
1946	3	3
1947	18	11
1948	39	17
1949	93	28

Fowls submitted to the Veterinary department for examination and tests for Newcastle disease should be live birds. They should be brought in by private conveyance, rather than shipped by rail or bus, to avoid danger of exposing other poultry. If distance is too great the blood of two or three of the sick birds may be collected in clean dry bottles and sent to the laboratory by mail. A letter and remittance of one dollar (\$1.00) for the diagnostic service should accompany the specimens.

Spread of Newcastle Disease

The disease may be spread either by direct or indirect contact. Once it is introduced into a flock none of the birds escape the infection. It is not always possible to determine the source of the infection. In the first outbreaks in the state, evidence pointed to introduction through chicks which were shipped in. It may be introduced or spread from one group of poultry to another on contaminated feed bags, crates, egg crates or litter. Visitors, wild birds, dogs, cats or vermin could

mechanically carry Newcastle disease virus from place to place. Transmission through the egg is possible if eggs laid in the first few days are used for hatching.

Control Depends On Quarantine and Sanitation

Medicines or vaccines have no curative value in flocks having the disease. Good care and feed will keep the losses at a minimum. Should there be more than one group of poultry on the farm, provide separate caretakers for the sick and the healthy birds. Provide a strict quarantine of the sick group, keeping out all visitors. As soon as the disease has subsided, the house should receive a very thorough cleaning and the litter burned. Chemical disinfection with a cresol or other dependable disinfectant should follow. There is no evidence at present of recovered birds remaining carriers of the virus.

Two Types of Vaccines Used

Two types of vaccines are being produced commercially for protection against infection. One is a virus which has been chemically killed, but does not produce as high or as long immunity as that produced by living virus vaccines. Its advantage is that it will not introduce an active virus into the flock. The live virus vaccines confer a more lasting immunity, but can cause serious loss in chicks under 4 weeks old. In laying flocks it causes a temporary drop in egg production. There is also the possibility of spread of disease to other non-vaccinated susceptible birds. It is hoped that experimental work will provide vaccines with less serious limitations. (Project 170. Veterinary Department.)

Losses

in stands

of Ponderosa Pine

By M. A. MAXON

SOUTH DAKOTANS have a high regard for trees, especially for the evergreens, whose dark winter beauty and dense growth are the best protection against the sweep of the winds. The hardest and most drouth resistant of these trees are the red-cedars and the ponderosa pine, which are native to the state and occur in abundance in the Black Hills. The ponderosa pine is the Big Tree of South Dakota for it is our only dependable conifer adapted to all our climatic zones.

Despite the fact that it is highly desirable for use in shelterbelts because of its long life and dense crown, and very drouth resistant once established, the low survival of the ponderosa after planting has limited its use in regions where the soil and climatic conditions are favorable. We find a number of older shelterbelts in the south and southeast sections of the

state but comparatively few in the central and western section. Yet this is a tree supposedly at home in all parts of the state where crops may be grown. Why then is it not used?

Losses of Seedlings Extreme

The answer lies in the trouble we have in getting the young plants through the first few years; losses of young seedlings the first year are extreme and further losses usually occur in the second and third years. Often seen are shelterbelts with a solid stand of elm, ash, or Russian Olive with many a gap in the pine rows.

How are we to overcome these losses in transplanting and insure a greater survival of the remaining plants during the first few years?

Early tests were made by Dr. Leon Snyder under an experiment station project which was set up to investigate ways of increasing the survival of



conifer plantings. A number of phases of the problem were to be studied, such as: source of seed, season to transplant, use of potted plants, seedling protection, effect of soil type and benefits of watering. In the spring of 1942, Dr. Snyder started a series of tests along these lines. These tests with potted seedlings compared with bare-root seedlings showed a slight increase in survival for the potted stock. Actual figures on this test were 87 percent survival for potted plants against 74 percent for bare-root plants.

Wax Coating Tested

Studies of protective devices were undertaken by Dr. Snyder, using Dowax, a wax emulsion, as a coating to check loss of water from the leaves. Also tested at the same period were the plant hormones, or root-forming chemicals: indolebutyric acid, vitamin B₁, and the commercial preparation, "Rootone." Although the test was on a small scale, it indicated a benefit from treating with Dowax.

The war interrupted further work until 1947, when Leonard Yager and S. A. McCrory made new test plantings on a larger scale than before. Feeling that the basic cause of failure lay with the individual seedling makeup, these workers divided the plants as they came from the nursery into two groups. Those plants with a well-balanced top and root were graded No. 1; those poorly rooted or tap-rooted, were graded No. 2. Poorly developed, injured and dead seedlings were, of course, discarded. This graded the plants on easily recognizable points.

Root-Forming Chemicals

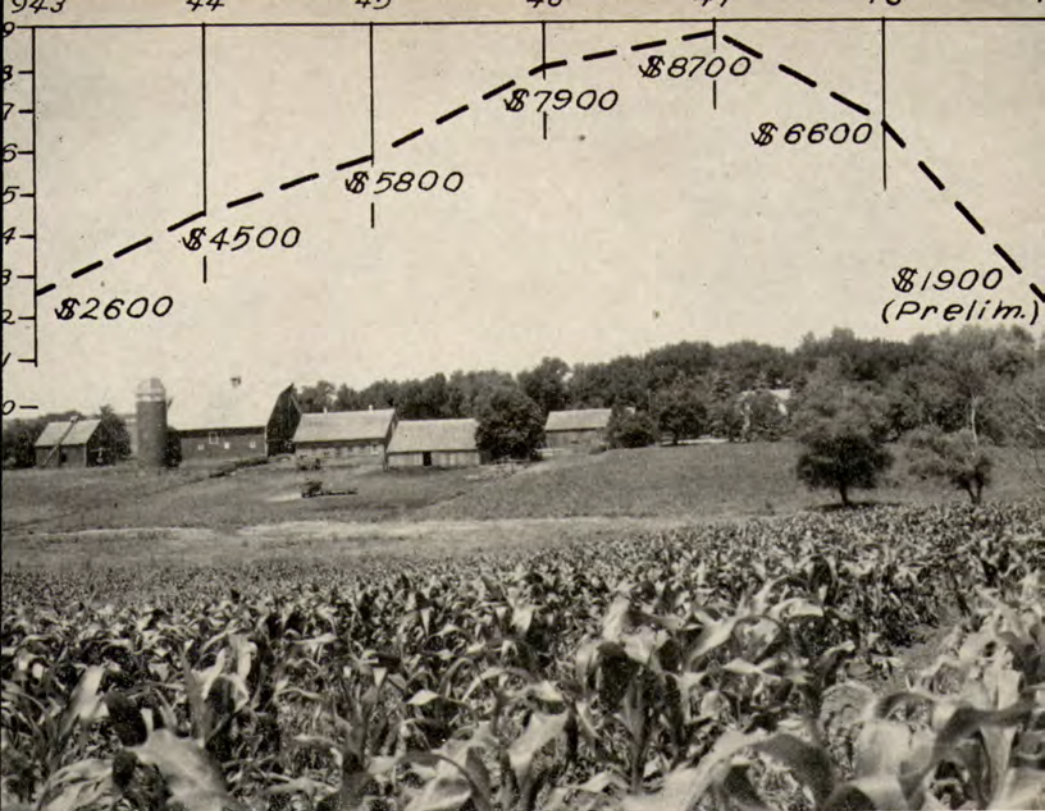
A series of trials were then run on both these grades, again using root-forming chemicals: naphthaleneacetic

acid, indolebutyric acid, naphthalene acetamide and vitamin B₁. These materials have been widely used for root stimulation on cuttings and on transplants. Seedlings were dipped into a weak solution of these chemicals for a short period, then washed and planted. Counts were then made on their survival in the field in 1947, 1948 and 1949. Treatments with the chemicals did increase the survival of both grades of cuttings, especially those treated with naphthalene acetic acid and vitamin B₁, but the test showed that No. 1 grade plants had a much better record of survival than No. 2.

Again in 1949 these two most effective chemicals were tested on a large number of plants graded as before into two groups. In addition, plastic emulsions: Goodrich polyvinyl resin latex (Geon, formerly) and the same substance in a commercial brand, "Plantcote," were used to give the seedlings a thin coating to check loss of water from the leaves. Late planting and a dry summer practically wiped out these trials but again the No. 1 grade plants survived in greater numbers and most of the No. 2 died.

This then seems to be an indirect way of saying that the best plants grow best.

Although treatments with chemicals and waxes may be helpful in raising the percentage survival of transplants, the essential ability to survive seems to lie within the seedling. Plants of hardy drouth-resistant seed stock, well-grown in the nursery and so handled by the nurseryman and farmer that little loss of vitality occurs between digging and planting may be the answer to the problem, provided good care is given after planting. (Project 142. Horticulture Dept.)



Trend in labor returns of selected farms in north central South Dakota, 1943-49.

Farm Income in the *Red*?

By RUSSELL L. BERRY and MAURICE L. McLINN

WITH RAPIDLY FALLING farm prices and high fixed cost something more than a government farm program will be needed to keep farmers out of the red.

Ten farmers in north central South Dakota earned only \$1900 for their labor and management in 1949. These same farmers averaged nearly \$7000 return for their labor and management in 1948. While these farmers may not be representative of their area, they do suggest what is happening to farm incomes.

This difference in earnings was due

to lower farm prices, lower crop yields, and slightly higher operating costs on these farms. Drouth and hail made it necessary for farmers to use much of their rough feeds and grains. The decrease in their rough feeds was nearly \$4000 per farm as an average. These 10 farms are the first of 50 to be analyzed for farmers in this area. A more complete report on last year's farm earnings will be made in the next few months.

In the meantime, the "something" needed to keep farmers out of the red ink is easily seen from past farm rec-

ords furnished by nearly 100 farmers located in north central and southeastern South Dakota.

These records show that farm earnings are affected by several factors. Some of these are: (1) size of business, (2) labor use, (3) crop yields, and (4) livestock feeding. All of these factors affect efficiency of production, costs, or sales. While an individual farmer cannot do much about farm prices he may be able to do something about his size or volume of business and his efficiency. At least the spread between high- and low-income farmers suggest that this may be the best place to tackle the problem of falling farm incomes.

In 1948 a few South Dakota farmers had labor and management earnings of \$20,000 each, while a few actually lost money. What made the difference?

Size of Business Is Important

Size of the farm business is an important reason for variation in farm income. Size means much more than just acres in the farm. A 40-acre potato farm may have a larger volume of business than a two-section farm. It all depends upon what is done there, and that is best measured in days—days of productive work. Using this measure of size, eleven largest farms in the north central area averaged \$9,000 for their labor and management. This was twice as much as the eleven smallest farms.

The most profitable farms in the southeast were 65 percent larger than the least profitable farms. In the north central area the most profitable farms were 80 percent larger than the least profitable. The most profitable farms averaged over 400 acres in the south-

eastern counties and 1500 in the north central counties.

Such figures may suggest that all farmers should attempt to enlarge their farms, but this is not always true. Many efficient farmers might lose much of their efficiency on larger farms. As a result, their net income would be smaller on a larger farm. Some farmers lack the ability to manage large farms, and they do much better on small farms where their attention to detail makes them more efficient.

While some large farms make less money than the more profitable small farms, there is good reason to believe the more efficient small farmer would keep much of his efficiency even though he had a larger farm. This is particularly true when small grains and beef cattle are the chief enterprises that would be expanded. Expanding the business by adding a large poultry or dairy enterprise would generally require more managerial ability than would an increase in size of beef cattle or small grain enterprises.

Increase in Farm Size Necessary for Efficient Use of Equipment

The tractor and combine have, in effect, reduced the size of wheat farms the same way that the airplane has reduced the size of the earth. Many of these farms are too small for efficient use of the equipment available. As a result, costs are high and fixed at the moment when they should be lowered. Adjusting farm size to fit modern tractors and combines is needed.

A recent study indicates that 80-cent wheat would give a labor and management income of \$1,100 on an 800-acre wheat farm at 1944 costs, and

require only 30 days hired labor. If this same farm were operated as two farms of 400 acres each, the labor and management income would be only \$340 each.

Many farms in the north central area have been enlarged by buying or renting additional land. Farms have increased from an average of 1000 acres to 1200 in the five years, 1944 to 1948. This change may be exaggerated by the turnover in farm record keepers, but it is characteristic of the general trend.

Such an increase in farm size is necessary, in many cases, in order to use Diesel powered tractors and other large and expensive equipment to best advantage.

Size of Farm Business Increased by Adding More Livestock

Size and volume of farm businesses have also been increased by adding more livestock. In the years 1944 to 1948, the labor required to care for livestock in the north central area increased 100 days. Livestock units increased from 68 to 80 during the same time. The number of beef cows increased from 25 to 33, as an average, for the record keeping farms. There is reason to believe that farmers capable of handling 30 head of beef cattle could, in most instances, handle twice that many with little loss in efficiency. To increase the livestock numbers in this manner requires more grazing and hay land than it may be possible for the farmer to rent or buy. Buying additional land would appear to be risky, especially if credit is used.

Buying feed to produce more livestock may be the easiest way for these farmers to increase the size of their farm business. Adjustments should be

made slowly until the farmer is certain that the increased volume will not be offset by less efficiency.

Shifting about 25 percent of the cropland to legumes and grasses has been proposed. This may be a profitable alternative to summer fallow or green manuring, especially, since it would permit an expansion of the livestock enterprises to increase the volume or size of the farm business.

On rented land the lack of buildings, fences, water supply, or location with respect to the tenant's farmstead may make such a program impractical. The tenant will hesitate to seed legumes and grasses on land rented by the year. The landlord may find it more profitable to let the land lie fallow. Perhaps grass and legume seed production may be the solution on some of the rented land that cannot be adapted to livestock production. There are reasons to believe that there will be a comparatively strong demand for legume and grass seed for several years.

Irrigation in the James River valley may ease the population pressure and permit an expansion of the size of dry-land farms. This will be true if many of the dry-land farmers on inadequate sized farms shift to irrigation which requires less acreages. On the other hand if irrigation farmers come in from other areas there may be little opportunity to expand the size of dry-land farms unless some of our present farmers find more attractive opportunities in other lines of work.

Efficient Use of Labor

Labor is one of the most important costs of farming. This is true even though the farmer does not have a hired man. His own labor could be

marketed, as a hired man or perhaps as a manager of an elevator or some other business. Therefore his labor is valuable whether his farm keeps him fully employed or not.

A good manager uses his labor on the enterprises that give the greatest labor and management wage for the year. He will attempt to keep himself fully employed by adjusting the size of his business and by choosing enterprises that require labor at different times. Livestock uses labor during the winter months when field work cannot be done. Dairy, poultry and hog enterprises use much labor and are particularly suited to small farms. Table 1 shows that some farmers do almost three times as much work as others. As a result they are able to get larger farms, handle more livestock, and make more money. Similar figures can be given for the southeastern area. Again it should be remembered that half of the larger farms made less than \$10,488. Some of these farms made less earnings than did smaller but more efficient farms.

Table 1. Days of Productive Labor per Man and Labor. Earnings on 43 Farms in North Central South Dakota, 1948.

Days work per worker		Number of farms	Average operator's labor earnings
Range	Average		
Under 235	181	11	5,105
235-440	343	21	5,724
440 & over	574	11	10,488

How can a man do more work than there are days in the year? The answers are that he may work "day and night," or he does his work more efficiently, or both. Efficiency that results from desirable size of farm, enterprises, labor saving machinery, equipment, and work methods is important.

Judgment Needed in Adjusting Crop Yields and Livestock Feeding

Higher crop yields are desirable if the cost of summer fallow, green manure crops, grasses and legumes, or fertilizer do not exceed the value of the added yields. When grass and legume seeds are expensive it may pay farmers to prepare better seed beds and plant less seed per acre.

Feed costs are the largest single item of expense in livestock production. Farmers differ greatly in the amount of feed used to produce a hundred pounds of pork, beef, or milk. More important, they differ as to the cost of feed per hundred pounds of meat. Successful farmers consider carefully the possibility of substituting one kind of feed for another. When hay is high priced it may pay to feed more grain. When grain is high it may pay to feed more hay or to depend on pasture.

Protein supplements substitute for several pounds of farm grains. Yet when protein supplements are high in relation to grains it may not pay to feed them free choice. Choices among the grains also need to be made. Careful judgment is needed to determine what proportions of hay, grains, and proteins will be most profitable. For example, it has been found by the Animal Husbandry Department that a ration of one-third alfalfa and two-thirds brome grass, when fed to ewes, can give as good results as feeding straight alfalfa.

The ability of farmers to analyze the effect of changing price relationships on their business and to make needed adjustments will determine how they will come through farming in the fifties. (Project 137, Agricultural Economics Department.)



Three rows of cottonwoods grown at Brookings in 1949. The row on the left is a strain highly resistant to the destructive leaf rust disease which is common in South Dakota. The middle row is a susceptible commercial strain. Note that the disease has killed all the leaves. The row on the right is another leaf rust resistant strain developed at this station.

Shelterbelt Cottonwoods *That Live!* . . . BY C. M. NAGEL

A NEW STRAIN of cottonwood which is resistant to leaf rust, has been developed by the Plant Pathology department of the Experiment Station. This new disease resistant strain when released to farmers, will reduce the losses in stands of the cottonwood tree.

Approximately 5,000 miles of shelterbelt and farmstead plantings have been planted in the state during the past 15 years. One of the important trees used in shelterbelt plantings is the cottonwood. Approximately 750,000 cottonwoods are planted each year in the state, and it is considered

one of the more permanent types of trees used in such plantings. During recent years, as a result of the number of dead cottonwood trees which appear in many of the shelterbelts and farm plantings, many farmers hesitate to use them as commonly as they did during the 30's. Experimental evidence indicates that one of the major hazards responsible for these mortalities is the damage caused by leaf rust, which weakens and ultimately kills cottonwood stands.

Research investigations were undertaken in 1944 to work out control

measures because of the damage which occurred in shelterbelt and farmstead tree plantings by this destructive disease. It resembles in appearance the rust which attacks small grain. However, it is distinctly different in one respect and that is, it will not infect small grain, but only the cottonwood tree, in so far as is known at the present time.

In those cases where the leaf rust damage is not sufficient to kill the trees, they are so seriously weakened that other diseases become very destructive, particularly the canker diseases which girdle the bark on the branches and main trunk of the tree.

Trees Defoliated by Rust

Leaf rust appears on leaves of cottonwood trees about the first of August. Under conditions favorable to rust infection, it becomes so heavy that both surfaces of the leaves are covered with rust, and in about ten days on highly susceptible trees the leaves turn brown and drop. Frequently, the susceptible cottonwoods are defoliated from rust by the middle of August. Once the leaves of a tree are killed, the plant cannot manufacture sufficient food, which is stored in tissues of the plant, to protect it from low temperature damage during the winter months, and the tree may starve to death. As a result, by spring the trees are either dead or in a weakened condition.

Experiments conducted during the past several years attempted to find a method of control for this destructive disease, and a search was made for a leaf rust resistant type. Several hundred strains of cottonwoods have resulted from greenhouse and field plot investigations since 1944. The strains

under test included not only commercial stocks, some of which defoliated 100 percent during the peak of the leaf rust attack, but also a wide range of resistant strains resulting from greenhouse inoculation tests, which seldom lose any leaves under similar leaf rust attacks. Still other strains are virtually immune to this particular leaf rust disease.

The experiments were conducted in Brown County at Hecla in cooperation with the Brown-Marshall Soil Conservation district, and at the Experiment station located at Brookings.

Damage by Leaf Rust Mistaken for Lack of Winter Hardiness

Under certain conditions the damage caused by disease has been confused with a lack of genetic hardiness to low winter temperatures in the case of cottonwood trees. Actually the so-called winter-killing under conditions of heavy leaf rust the previous season seems to be directly associated with this disease. Its damage during the previous seasons cuts down on the normal food production, causing a weakened condition which makes the plants susceptible to ultimate killing when they had previously appeared to possess sufficient genetic hardiness. In this connection, experiments have demonstrated that strains of cottonwood which possess sufficient winter hardiness do become injured and are killed if they have been seriously defoliated and weakened during previous seasons by the leaf rust disease.

Further trials are underway and, if these continue to prove satisfactory, plans will be made for the release of a leaf rust resistant cottonwood for planting in South Dakota. (Project 142. Plant Pathology Department.)



These instruments and pellets, though small, produce big results in daily gains of lambs.

Implanting a stilbestrol pellet in lamb's neck.



Stilbestrol

**Boosts
Lamb Gains
20%**

By R. M. JORDAN

IT DOESN'T REQUIRE a miracle to increase the daily gains made by feeder lambs by about 20 percent and lower the feed required to put that gain on by an equal amount. About two cents worth of chemical will do the job, a chemical which reacts in the body much like the female sex hormones and is called stilbestrol (pronounced still-bess-trol). This is the same chemical that poultrymen have been tenderizing roosters with during the last few years. Cattlemen also have increased the daily gains as much as a third of a pound a day with this same chemical.

The administration of the pellet is

fast and simple. This chemical, with hormone-like properties, comes in little pellets about half the size of a kernel of wheat, and is deposited under the skin of the animal in the region of the neck. After the pellet has been deposited, there is no further treatment required, though, of course, a good well-balanced ration is required in any successful feeding operation.

First Trial Conducted on Suckling Lambs

To substantiate early findings and cast further light on the subject, a series of trials were conducted at the South Dakota State College Experi-

ment Station during 1949-50. The first trial was conducted with young suckling lambs of about one to two months of age. Twelve pairs of twin lambs of which both lambs in the pair were of the same sex were used in order to minimize genetic variation between the lambs. One lamb of each set of twins received a 12-milligram pellet of stilbestrol implanted just under the skin. All of the lambs in the experiment received grain and hay in a creep, plus their mother's milk. The ewes were fed alfalfa hay, free choice, plus about one pound of grain per head daily until about May 15, at which time the ewes and lambs were turned onto grass and no grain was fed either the lambs or ewes after that period.

Capacity of Suckling Lambs to Grow Cannot Be Accelerated

The effect of stilbestrol treatment on the rate of gain in suckling lambs is summarized in Table 1. Results indicate that treating suckling lambs with 12 milligrams of stilbestrol did not increase the rate of gain. On the other hand, the treatment did not cause any dwarfing, as normal growth was made in all treated lambs. In addition, the hormone did not cause a cessation of the reproductive ability, as both ewe lambs and ram lambs proved to be fertile in later tests. Further experiments will be conducted to obtain additional information on this

subject, but at this time the work of this station indicates there is no object in planting stilbestrol pellets in young suckling lambs, as apparently inherent capacity to grow is at a maximum and cannot be accelerated with the implantation of 12 milligrams of stilbestrol.

Fattening Lambs Four Months of Age Treated

Two other trials were conducted to determine the effect of stilbestrol on fattening lambs. In the first trial the lambs treated were about four months of age. Four lots of 13 lambs each were full-fed from August 22 to November 5, a period of 74 days. These lambs received a full feed of corn, soybean oil meal (10 percent by weight), and brome hay. They had access to fresh water and salt. No attempt was made to equalize the feed intake as it was felt that it was quite important to determine whether the treatment of stilbestrol would increase the feed intake per day. Each lamb in two of the four lots was treated with a 12-milligram pellet of stilbestrol, implanted just under the skin below the ear. The other two lots were not treated and served as the check lots.

Treated Lambs Gain 20 Percent More

The effect of stilbestrol on fattening lambs is given in Table 2. In the first trial the results of the treated lambs from Lots I and III were averaged together in one group for ease of presentation, making a total of 26 lambs, and Lots II and IV were grouped together making a total of 26 lambs in the control group. The treated lambs gained .43 pound a day over a 74-day period, whereas the control lambs gained .35 pound per day for the same period. As shown in Table 2, there was very little

Table 1. Effect of Stilbestrol on Rate of Gain of Suckling Lambs

	12 Milligram Stilbestrol	Controls
Number of lambs	12	12
Days on feed	90-105	90-105
Initial weight	24.0	25.0
Final weight	72.8	74.7
Total gain per lamb	48.4	48.8
Average daily gain	.469	.478

difference in their daily feed consumption, and the carcass grades of treated lambs were equal to the control lambs. As might be expected, the lambs that gained the fastest also were the most efficient in their feed utilization, inasmuch as the lambs in Group I required only 362 pounds of corn per hundred pounds of gain and the control lambs required 411 pounds.

7-Month Feeder Lambs Used

To get further information, a second trial was conducted using feeder lambs that were about seven months of age. These lambs were divided into two groups of 25 lambs each and were fed for a period of 92 days. They were sheared before being placed on the ex-

periment and received a full feed of corn, soybean oil meal, and brome hay in a manner similar to that in the first trial. Twenty-five of the lambs had a 12-milligram pellet of stilbestrol implanted under the skin. The results of this experiment are also given in Table 2.

The treated lambs gained .37 pound per head daily, and the control lambs gained .29 pound per head daily. It is the opinion of this station that the slower daily gains made in the second trial, irrespective of treatment, were due to the fact that the lambs were poorer quality to start with. As with the first group of feeder lambs, the daily gains were significantly greater for those lambs that were treated.

Table 2. Effect of Stilbestrol on Growth Rate, Feed Consumption, Feed Efficiency, and Carcass Grade of Lambs

	Trial I (Feeding Period 74 days)		Trial II (Feeding Period 92 Days)	
	I Treated Av. Lots I & III	II Controls Av. Lots II & IV	I Treated	II Controls
Number Lambs	26	26	25	25
Growth Rate (lbs.)				
Average initial weight	62.1	63.5	69.1	69.2
Average final weight	93.9	89.7	103.1	95.7
Gain per lamb	31.8	26.2	34.0	26.5
Daily gain per lamb	0.430*	0.354	0.370†	0.289
Average Daily Feed Consumption (lbs.)				
Shelled corn	1.56	1.46	1.90	1.85
Soybean Oil Meal	.15	.14	.19	.19
Brome Hay	1.17	1.20	1.39	1.40
Total	2.88	2.80	3.48	3.44
Feed per 100 pounds of gain (lbs.)				
Shelled corn	362	411	501	626
Brome hay	272	339	371	480
Soybean oil meal	36.2	41.1	50.2	62.6
Total	670.2	791.1	922.2	1168.6
Carcass Grade‡				
Carcass grade in number				
U. S. Choice	9	9	1	3
U. S. Good	5	5	6	19
U. S. Commercial			12	3
U. S. Utility			6	

*Difference was significant (P 0.05) over controls

†Difference was highly significant (P 0.01) over control group.

‡Few lambs in the first trial were not sold.

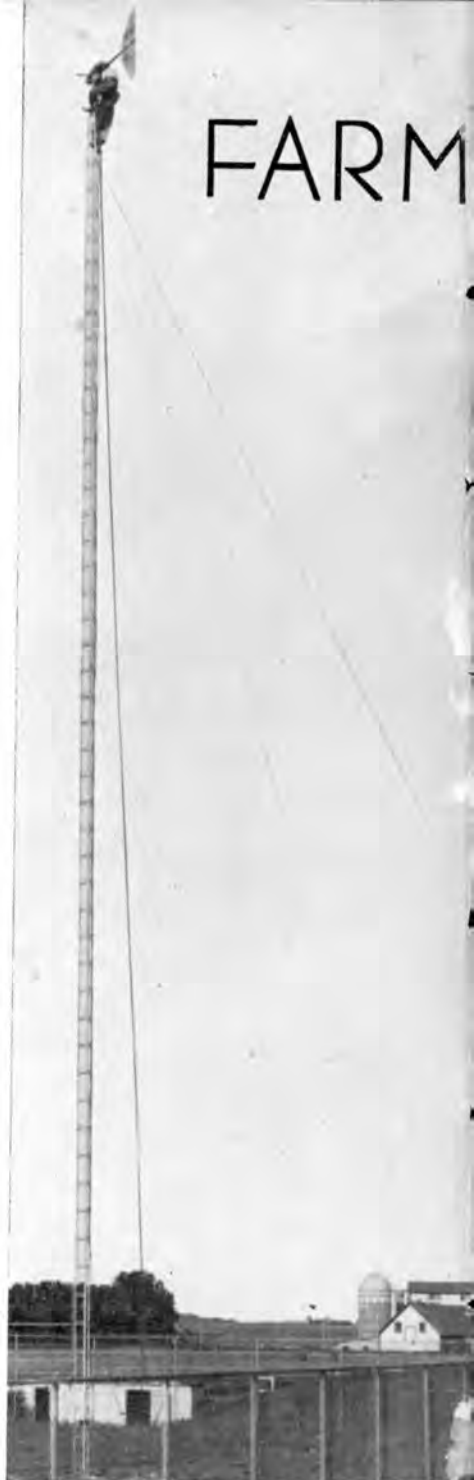
About 15 Percent Less Feed Required for Treated Lambs

Again the feed consumed per head daily was not affected by the treatment. The feed required per hundred pounds of gain was about 15 percent less for the treated lambs than that required for the control lambs. However, in this trial in which lambs of about seven months of age were treated, the effect of stilbestrol on the carcass quality was quite marked, inasmuch as the lambs that were not treated graded on the average about one grade higher than those that were treated. It would appear from these two trials that the best results can be obtained from treating lambs that are four to six months of age.

Lambs treated when they are older will make greater gains than untreated lambs, but their carcass quality may be lower. In spite of that shortcoming, an increase of about 20 percent in daily gains, accompanied by a decrease of 15 to 20 percent of feed required per hundred pounds of gain, cannot be treated lightly or overlooked if one is to make maximum profits from the lamb feeding venture. Whether breed differences, such as slow-maturing Rambouillet lambs as compared to early-maturing Hampshire or Suffolk lambs, would have a significant effect on the carcass quality is not known at this time.

At the present time, the Pure Food and Drug Administration does not sanction the use of stilbestrol for large farm animals. It is studying means of determining stilbestrol content in the tissue of meat as the basis for possible approval of the use of stilbestrol in the not too distant future. (Project 199, Animal Husbandry Department.)

FARM



LECTRIFICATION

By H. H. DeLONG

MANY FARMS await modern facilities and the coming of electric light and power. Eventually they may have central service, but some may be in territory so thinly populated as to make such service very expensive. Others have possibilities of using gasoline-electric plants or other types of electrical plants a few years while they wait for highline service. Others may wish to know the cost of maintaining a standby plant, even after they have highline service, to give added security against line damage from storms.

Electric service provided by a central station is conceded best for thickly settled areas. No doubt, however, there is an economic limit to how many miles of line can be run to serve one farm.

Two Types of Plants Selected for Comparison

Two types of farm electric plants were selected for study from the many kinds and sizes available (Table 1), and their cost of operation compared to the cost of electric power from a central station service.

The plants selected for the research on "cost of operation" were those which could match as nearly as possible the voltage and current of central service, and those which would be automatic in their operation. An automatic gasoline-electric plant producing 110-volt, AC, 60-cycle current was one selection. Both a 1500-watt plant and a 3000-watt plant were used. These plants started automatically as soon as any load was turned on. Any of the common appliances used on

highline service could be used, but the smaller plant would not start when several large appliances came on at once.

The other plant tested was a wind-electric 110-volt, DC with battery set of 180-ampere-hour rating. At the Brookings' test location it was mounted on a 105-foot guyed steel tower. The following year, when placed on the substation farm at Cottonwood, it was mounted on a 65-foot tower. The wind-electric plant was automatically controlled from a panel near the batteries, and the plant was turned on at all times. The propeller turned the generator at any time the wind was sufficient. A governor prevented excess speeds in high wind, and the automatic controls regulated the charging rate to fit the needs of the battery.

Lights, heating elements, universal AC-DC motors commonly used on the highline were used on this plant. The larger electric motors had to be shunt wound DC motors. The refrigerator used as a test load had to be of the open motor type with belted compressor.

The plant performed without mishap, except for a broken insulator due to a defective part, and it was able to ride out all high winds of the period without damage.

Test Procedures Set-Up for the Automatic Engine Plants

The gasoline-electric light plants were of the two-cylinder, air-cooled design, with direct, connected generator. They were mounted on a concrete base, but had rubber shock ab-

sorber mounting bushings. The room was dry and well-ventilated, although winter temperatures did get down to below freezing.

Each plant had its automatic control box mounted above it on a panel. The output current went to a watt-meter, and thence to the outlet panel. One outlet for each plant was hand switched for testing purposes. Each plant had an outlet to which machines with their own automatic switch could be attached. In addition, each plant had several outlets controlled by relay switches operated by a master rotoswitch.

Plants Carry Typical Farm Load

The roto-switch turned once in every 24 hours, and it could be set up so as to turn on loads at various times of the day. For most of the test period the plants were run on a loading pattern that resembled typical farm power and light load. That is, lights were turned on for a short time in the morning and from 5 p.m. in the evening. Figure 1 shows the pattern of the daily loads for the plants. Each was loaded with three appliances:

lights, a heating appliance and a motor.

Special tests were run with gasoline-electric plants to test their dependability and ability to handle loads. A refrigerator was added to the 3000-watt plant load for one month. The plant handled this additional load above its average of 6 kwh per day and fuel costs increased sharply due to the much more frequent starting and stopping of the plant. Daily consumption increased from 6 to 8 kwh and daily fuel consumption from $2\frac{1}{2}$ to 5 gallons.

Records Kept on Fuel Consumption

Records were kept on fuel consumption, kwh of current generated and labor for care and servicing. These costs when added to depreciation and interest represented the total cost of the plant. Total cost for a period divided by the kwh generated for that period gave the unit cost for the electricity. The fuel consumption curves for the 3000-watt plant at various loads are given in Fig. 2. The large plant was slightly more economical and, in addition, could start under

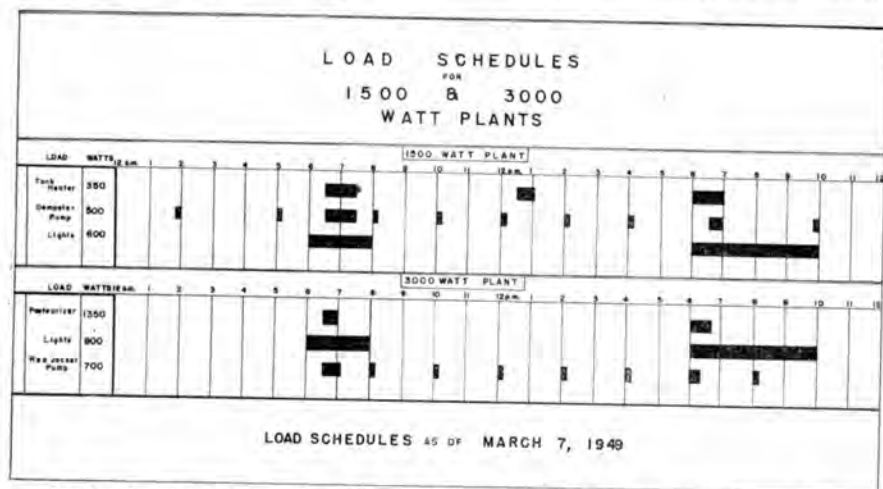


Fig. 1. Time chart showing the "on" periods during the day for the gasoline-electric plants.

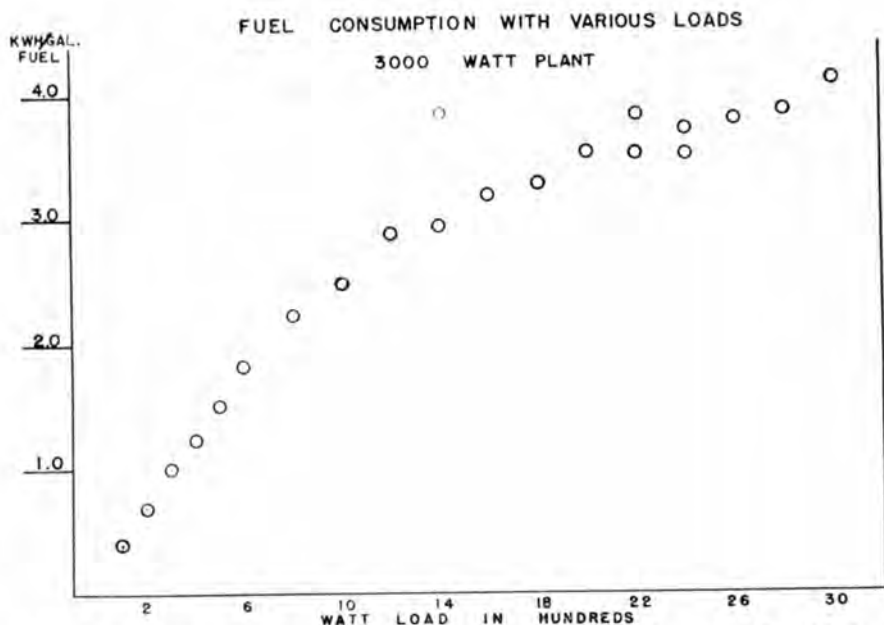


Fig. 2. Maximum loading of the 3000-watt plant gave the highest kw-hours per gallon of fuel.

Table 1. Initial Costs of Various Farm Electric Light Plants

Plant Size and Description	Approximate First Cost	Approximate Cost
350-watt gasoline-electric, 32-V DC, manual control	\$400	\$500
1000-watt gasoline-electric, 32-V DC	400	525
1000-watt gasoline-electric, 32-V DC, complete with battery set	540	600
2000-watt gasoline-electric, 32-V DC, complete with battery set	650	700
350-watt gasoline-electric, 110-V 60c, AC, manual controls	\$175	\$225
750-watt gasoline-electric, 110-V 60c, AC, manual controls	200	250
1000-watt gasoline-electric, 110-V 60c, AC, manual controls	250	300
1500-watt gasoline-electric, 110-V, 60c, AC, automatic controls	400	550
3000-watt gasoline-electric, 110-V 60c, AC, automatic controls	475	575
12-V small size wind-electric, 20' tower, automobile-type battery set	\$160	\$200
32-V small size wind-electric plant, guyed tower 60' high, 180 ampere hour battery set	700	800
32-V large size wind-electric, guyed tower 60' high, 400 ampere hour battery set	1400	1600
110-V large size wind-electric, guyed tower 60' high, 180 ampere hour battery set	1700	1900

Table 2. Operating Costs for 3000-Watt Powerlite Plant with Various Daily Consumption

Totals				Costs per Kilowatt Hour							
Daily Consumption KWH	KWH Generated	Hours Run	Cost of Fuel Consumed	Fuel Consumed	Labor for Refueling	Oil	Repairs	Service and Repair Labor	Depreciation	Interest on Investment	Total Cost
4	48	84	\$ 6.43	\$0.13396	\$0.0125	\$0.0245	\$0.0044	\$0.0188	\$0.1312	\$0.0206	\$0.3478
5	110	154	13.49	.12264	.0099	.0158	.0035	.0150	.1050	.0164	.2883
6	210	245	21.38	.10181	.0083	.0163	.0029	.0125	.0875	.0137	.2431
7	56	56	5.19	.09264	.0071	.0139	.0025	.0107	.0750	.0117	.2137
8	24	21	2.08	.0867	.0062	.0121	.0022	.0094	.0656	.0103	.1924
Operating costs for all loads during entire period Jan. 8—May 26											
840	957			.10844	.0083	.0138	.0018	.0071	.0833	.0138	.2366

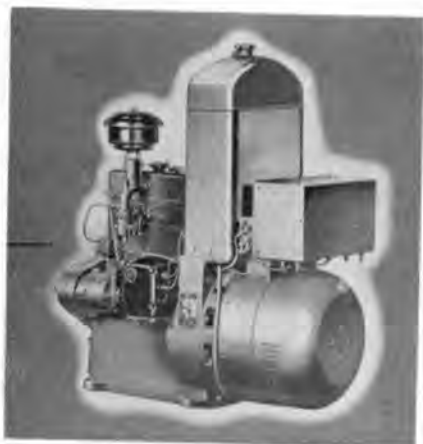
Note: Daily running time assumed constant at 7 hours.

heavier loads. The total costs per kwh are shown in Table 2, with individual cost items and the totals under various loading conditions.

Only Minor Repairs Needed

One operator had full charge of both light plants and a careful record was kept of all time spent with the plants. At times daily refueling was necessary, because the original fuel tanks of 5-gallon capacity were used. This need not be the size of tank used on regular farm installations. Oil was changed according to manufacturer's instructions.

At the manufacturer's specified times, the engine heads were removed and carbon deposits removed from piston and cylinder head. Only minor repairs were needed, such as an oil leak on the small plants, one fuel pump replacement, governor resetting to keep the plants on 60 cycles per second, and slight trouble with the breaker point assembly. Only one minor replacement was necessary in the automatic control cabinet, that of an electrical relay.



A typical gasoline-electric farm light plant.

Although not needed on the test plants during the test period, a periodic overhaul is advisable in the life of any frequently-run gasoline engine. Cost of an overhaul was included in total cost estimates.

Valuable Features Offset High Cost

While cost of electricity for the gasoline-electric plants is high, 2½ cents per kwh, plants of this type have several valuable features. First, the plant can produce electric service for the isolated farm or ranch. Secondly, it can hurry the process of farm electrification while the farm owner waits for a proposed line to be built into his territory. (The same appliances can be used.) Thirdly, the automatic plant can be used for standby service by the REA consumer in case of outages due to storm damage of lines.

Records for more than two years show the cost of electricity generated by a 110-volt, DC, wind-electric plant to be from 9 to 10 cents per kwh. A plant similar in capacity, but with 32-volt battery set will generate current for 7 or 8 cents per day. This is for an average daily consumption of 5.55 kwh.

Retail rates of most of the rural electric cooperatives in South Dakota average 3¼ to 3¾ cents per kwh, line density of one farm per mile to 2½ farms per mile, and average consumption per farm of about 150 kwh per month.

Calculations show, however, that current costs would have to go up as line costs increased, so that in territory where there were three or more miles to one consumer, the cost would become greater than for some of the alternate methods. (Project 188, Agricultural Engineering Department.)

HOW DO egg marketing practices in South Dakota compare with those in other states? Are eggs marketed in South Dakota equal or inferior in quality to eggs marketed elsewhere in the Midwest?

The answer to these questions is of interest to South Dakota consumers and to the industry in appraising their competitive position in the large central markets of the middlewest and the east. To some extent, the answer may be found in a survey which was conducted on a cooperative basis by experiment stations of 13 north central states. This survey attempted to ascertain the quality of eggs sold by the farmers to the first buyer and to analyze the loss in quality that occurred as these eggs moved from the country buying stations to larger assembling plants. In addition, various methods of marketing eggs by egg buyers and central assembling plants were studied and their influence on the quality of eggs analyzed.¹

¹Spec. Bul. 361 of Michigan State College.

egg marketing losses

Characteristics of the Country Buyers

In South Dakota, 23 country stations were studied. The volume of eggs handled by the various types of stations was small, as Table 1 suggests, ranging from 250 cases per year for the smallest, to 30,300 cases for the largest buyer. For most of the stations, egg sales did not form an important part of the total business. Fifteen out of 21 stations reported that between 90 to 100 percent of all eggs were delivered by farmers at the stations.

Eggs were delivered mainly on Wednesdays and Saturdays, almost one-third of the eggs coming in during the weekend. A large proportion

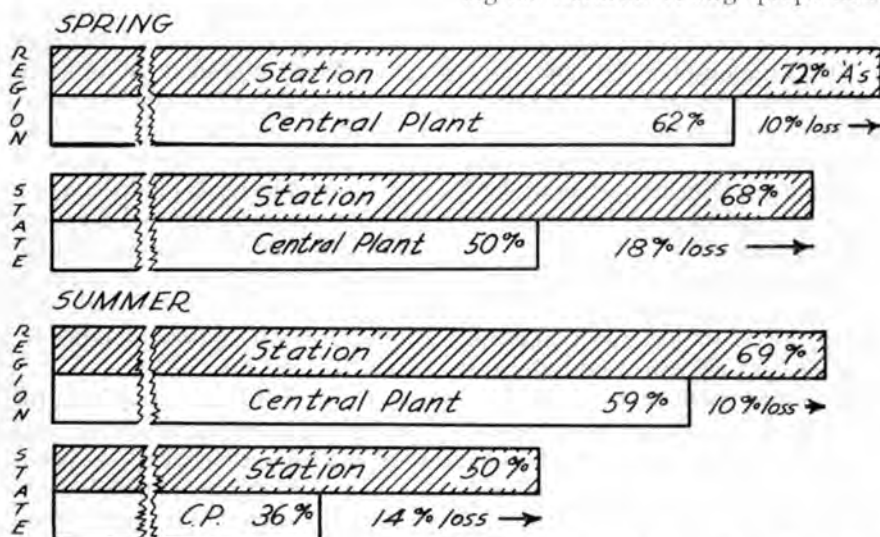


Fig. 1. Percent of "A" eggs (including stains and dirties) at the station and central plant, spring and summer, for South Dakota and the region, showing how many "A" eggs were lost between gradings.

Table 1. Volume of Business of 22 Country Egg Buyers* by Type of Business (1947)

Type of Business	Number	Total Eggs Purchased (cases of 30 doz.)	Average
Retail grocery	4	1950	487
Cream station	3	3000	1000
Produce station	7	68056	9723
Hatchery	1	600	600
Independent creamery	3	6080	2027
Cooperative creamery	4	46778	11695
Total	22	126464	5749

*One produce station did not report the number of cases purchased.

Table 2. Candling Practices of Egg Buyers, by Method of Purchase from Farmers

Method of Purchase from Farmers	Number of Stations Candling All Eggs	Number of Stations Not Candling All Eggs
Purchasing all or some eggs on graded basis	3	1*
Purchasing all eggs on loss-off method	6	7
Purchasing all eggs on current receipt basis	4	2

*This station reported grading some eggs, but also reported no candling.

Table 3. Percent of "A" Eggs* on Delivery by Farmers (Producer Lots) and One Day After (Other Receipts), South Dakota and North Central Region Compared

Type of eggs	Spring		Summer		Fall		Average	
	S. D.	Region	S. D.	Region	S. D.	Region	S. D.	Region
Producer lots	55.3	65.4	53.5	64.2	59.6	71.6	55.4	66.7
Other receipts		60.4	25.6	53.0	62.2	71.2	33.9	60.2

*Not including stains and dirties of A quality.

of the stations reported weekly door delivery, and no station reported that farmers brought their eggs more than twice weekly at any time of the year.

Of 23 stations, only one station reported that it bought *all* its eggs from farmers on a grade basis, although three purchased *part* of their eggs on a grade basis. Nineteen stations handled all eggs ungraded (current receipt or "loss-off").

As becomes apparent from Table 2, not enough buyers candled their eggs, since only 13 stations reported candling all eggs all year round and one station reported no candling at all.

Only eight stations held all or part of their eggs in a refrigerated cooler. On the day of the survey, 15 stations were holding their eggs at a temperature ranging from 65-70°.

Quality of Eggs Marketed by Farmers and by Stations

In order to determine the quality of eggs, a total of 456 lots of 100 eggs each, selected at random out of farmers' shipments, were graded on federal standards and the amount of "A" eggs determined. Three hundred sixty-three lots were graded on the day they were received and therefore show how many "A" eggs out of a 100 a farmer sells ("producer eggs"). Ninety three lots were graded the day after delivery by farmers ("other receipts").

Results for the various seasons, for eggs graded on day of receipt and those graded one day after are shown in Table 3. In summer, farmers delivered only 53 percent "A" eggs; in fall the proportion of "A" eggs was still

only 60 percent. On the average only 55 out of a 100 eggs sold by farmers were clean "A" eggs.

Holding eggs for one day at the station strongly affected the quality of eggs since, on the average, only 34 percent of the "other receipts" were "A" eggs.

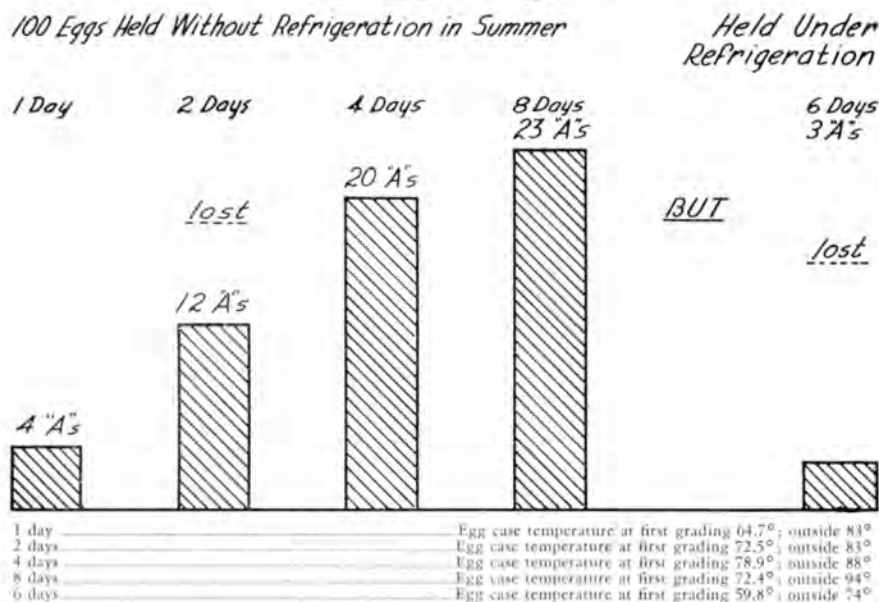
Poor Holding Conditions at Buying Stations

Poor holding conditions such as lack of temperature control, and number of days eggs were held between receipt and shipment adversely affect the quality of eggs. One hundred thirty-four lots were graded in spring and summer, first at the station and then at the central plant ("paired gradings"). Fig. 1 shows how many "A" eggs were lost between gradings in South Dakota and in the region as a whole. It indicates that South Dakota has a long way to go before its egg

marketing practices will approach those of the states farther east.

It is well known that the loss in quality of eggs increases with the days they are held. In the survey, eggs were not held under identical conditions and therefore the results shown in Fig. 2 referring to loss of "A" eggs according to number of days held at the station, are not strictly comparable. They demonstrate, however, how the length of time eggs are held and the temperature in the holding room, or outside, contribute to quality deterioration. This is first class evidence that where marketing practices are poor, financial losses to farmers and handlers are inevitable and the consumer is getting a poor quality product. (Project 175. Leaders: E. Feder, Agricultural Economics Department, Wm. Kohlmeier, Poultry Department.)

Fig. 2. Samples of 100 eggs held with and without refrigeration in the summer, showing loss of "A" eggs.





HARVESTING PRAIRIE HAY for *Greater*

By G. E. STAPLES

OUR PRAIRIE GRASSES can be harvested as hay anytime from late June up until the time winter weather prevents haying operations. The patient nature of this valuable crop in awaiting the harvest, together with the pressing work of the summer, causes many stockmen to lose sight of the fact that there is a "best" time to harvest prairie hay. Losses in valuable nutrients from prairie hay when the opportune time for harvest is past are not so evident to the eye as with such crops as our small grains. However, even though the grasses may change comparatively little in outward appearance from July to October, changes are taking place in the chemical composition of the grasses which exert great influence on their feeding value.

During the past few years research has been conducted to gain information on when prairie hays should be harvested for highest feeding value. The hays used in the study are designated Early, Medium, Late, and Storage hays. The early hay is usually cut

between July 1 and July 15 when the seed stalk is in a "shooting" stage. Medium hay is cut in August at a "seed ripe" stage, usually after August 15. Late hay is cut in a mature and over-ripe, or "seed falling," stage usually from Sept. 20 to early October. Storage hay is harvested at an early stage of maturity and tested over a period of years to determine the effects of storage on nutritive value.

These hays from three of our substations, Cottonwood, Highmore and Eureka, have been tested in feeding and digestion trials. The digestion trials are more technical in nature than the feeding trials and serve as a check on the feeding trials as well as give additional information on how the proportions of the various nutrients found in the hays influence digestibility.

Early-Cut Hay Gives Highest Daily Gains

Table 1 summarizes the results from the 1949-50 feeding trials conducted at Cottonwood. Each lot was fed the same amount of hay and sup-

plemented the same except that the pelleted soybean oil meal in Lot 6 contained 5 percent molasses and 5 percent urea. The early hay showed the highest daily gain (1.07 lbs.) closely followed by the one-year-old storage

hay (1.02 lbs.). The lot receiving medium hay, was in third place with respect to gains (0.90 lbs. average daily gains) closely followed by the two lots receiving the two-year-old storage hay (0.88 and 0.87 lbs.), showing that the supplement containing urea and molasses gave almost identical gains when compared to plain, pelleted soybean oil meal. The lot receiving the late-cut hay showed the lowest gains with 0.72 pounds average daily gain per head. Although needles were observed in each of the various cuttings of the hay, no trouble from needles has resulted during any of the feeding or digestion trials since this experiment was started.

Feeding Value



Savings of 500 to 600 lbs. of hay, over 40 lbs. of oats and 40 lbs. of soybean oil meal per 100 lbs. of gain resulted when early rather than late-cut hay was used in wintering calves

3-Year-Old Storage Hay Ranks High in Producing Gains

Results of the 1949-50 feeding trials at Eureka showed that the early and medium-cut hays in this trial gave gains that were identical. The hays were supplemented with 1 pound of oats and 1 pound of pelleted soybean oil meal, and the lots receiving the early and medium-cut hay rations produced 1.5 pounds average daily gain. The three-year-old storage hay closely followed these lots in producing gains, and the 1.4 pounds average

Table 1. Feeding Results 1949-50 at Cottonwood—Fed 112 days

	Lot 1 1-yr. storage hay plus supplement*	Lot 2 Late-cut hay plus supplement*	Lot 3 Early-cut hay plus supplement*	Lot 4 Medium-cut hay plus supplement*	Lot 5 2-yr.-old storage hay plus supplement*	Lot 6 2-yr.-old storage hay plus urea supplement†
Average daily gain	1.02	0.72	1.07	0.90	0.88	0.87
Feed offered per 100 lbs. gain						
Hay	1109.8	1538.9	1039.4	1225.4	1250.4	1257.6
Protein supplement	95.6	132.7	89.63	105.7	107.8	96.9
Oats	100.1	138.9	93.8	110.6	111.9	112.3
Percent of hay refused	9.91	13.10	14.54‡	10.87	8.67	8.46

*Supplemented with 1 pound each of pelleted soybean oil meal and oats per head daily.

†Supplemented the same as other lots except pelleted soybean oil meal contained 5 percent urea and 5 percent molasses.

‡It was noted that the early-cut hay contained larger than average amounts of "buck brush," *Symphoricarpos orbiculatus*, which accounted for most of the refused material here.

daily gain here was far superior to the 0.83 pound average daily gain produced in the lot receiving late-cut hay. The storage hay used in this trial was baled, stacked in a large pile and the pile topped with loose hay.

500 to 600 Pounds of Hay Saved on Early Ration

Experiments in wintering beef calves have shown that a gain of about 0.75 pound to 1.0 pound is a desirable level of nutrition. A calf should gain nearly 100 pounds during the wintering period. Comparing the early-cut hay ration with the late-cut hay ration in producing 100 pounds of gain, the early ration at Cottonwood saved 500 pounds of hay, 53 pounds of 40 percent pelleted soybean oil meal and 45 pounds of oats. Similar comparisons with the Eureka feeding trials show a saving of 605 pounds of hay, 43 pounds of oats and 43 pounds of pelleted soybean oil meal, where early-cut hay is used rather than late-cut hay to produce 100 pounds of gain. The storage hays would rank intermediate between the early-cut and late-cut hays in regard to feed saving per 100 pounds gain. These savings at feed prices during the past winter would result in savings of from \$6.00 to \$8.00 per calf, wintered under the conditions found in these experiments.

Early Hay Has 70 Pounds More Protein Per Ton

Protein is perhaps the most important nutrient in prairie hay; at least it is the nutrient most apt to be deficient and is an expensive nutrient to furnish. The 1948 yield of protein per acre at Eureka was 89.7 pounds for early-cut and 60.2 pounds for late-cut hay. The per acre protein yield for the

Highmore hay in 1948 was 107.4 pounds for the early, and 37.5 pounds for the late-cut hay. The early hay produced an average of 49.9 pounds more protein per acre, or over 70 pounds more protein per ton, as an average for these two stations than did the late-cut hay. It would require more than 150 pounds of 40 percent protein supplement added to each ton of late-cut hay to furnish the same amount of protein produced in a ton of the early-cut hay.

Digestibility of Late-Cut Hay Lower

The 1949 digestibility studies are the only ones complete, at present, which have not been previously reported. Table 2 shows the chemical composition and the coefficients of apparent digestibility for early, medium, and late-cut hays and two-year-old storage hay cut at an early stage of maturity. Both steers and lambs were used in testing these hays.

When hays of low protein content are fed alone they do not furnish as digestible a ration as when some protein supplement is added. This is attributed to the fact that protein is required to stimulate the growth of bacteria in ruminants; these bacteria are largely responsible for the breakdown of fiber and coarse materials, which in turn accounts for the greater efficiency with which sheep and cattle can utilize forages when compared to pigs, poultry, or other animals lacking such bacterial action.

From Table 2 it can be seen how poorly digested the protein of the late hay is, compared to the other hays. In these trials the early hay furnished more than five times as much digestible protein for steers as did the late-cut hay, while the same comparison with lambs showed the early-cut to furnish

Table 2. Chemical Composition and Coefficients of Apparent Digestibility (Steers and Lambs) of Eureka Hays—1949

	Dry matter	Crude protein	Ether extract	Crude fiber	Nitrogen-free extract
Chemical Composition percent					
Early	91.30	7.08	2.56	29.50	41.67
Medium	91.32	6.60	2.64	29.42	43.49
Late	91.79	4.75	3.10	30.37	43.64
2-year-old storage hay	91.44	8.35	2.60	29.85	41.04
Average coefficient of digestibility					
Early hay					
Steers	46.51	41.15	29.11	62.95	47.99
Lambs	40.55	34.38	19.12	54.03	46.66
Medium hay					
Steers	42.63	29.80	21.98	56.62	46.66
Lambs	40.25	30.35	15.34	55.38	42.36
Late hay					
Steers	40.51	11.88	37.39	56.96	43.79
Lambs	37.90	12.56	34.81	55.28	39.92
Storage hay					
Steers	46.44	45.98	34.60	59.26	47.04
Lambs	44.29	40.86	46.77	52.76	47.00

more than four times as much digestible protein as did the late-cut hay. (Found by multiplying the percent of chemical composition by the digestibility coefficient of the protein.) These studies show how the late-cut hay has two strikes against it: *first, late-cut hay contains considerably less protein than the early-cut, and second, the digestibility is much lower in the small amount of protein which the late-cut hay does retain.*

Acre Yields Average Higher for Early-Cut Hay

Acre yields of dry matter may prove to furnish the means of calling the third strike on the late-cut hay. Following is presented the pounds of dry matter produced per acre (an average from three stations) during two years.

Table 3. Pounds of Dry Matter Produced Per Acre (Average for Three Stations, Eureka, Highmore and Cottonwood)

	Early	Medium	Late
1948	1149.6	1024.6	970.7
1949	1376.0	899.2	743.3

In only one instance did the late-cut hay produce more pounds of dry matter than did the early-cut hay (late-cut at Eureka exceeded early by 5 pounds dry matter per acre in 1948); during all other years and at all other stations the early hay led in producing dry matter.

It Makes a Difference

Early cutting of prairie hay produces more nutrients per ton and per acre than does late cutting. Medium cutting is intermediate between early and late in producing nutrients, and both early and medium cutting is preferred greatly to late cutting in producing feed nutrients. Hay stored three years retains much of the original nutritive value, but should be cut early and well stacked for best results. If the operator wants to feed about one-third less hay and save on the concentrates, he should make hay in July rather than late September or October.

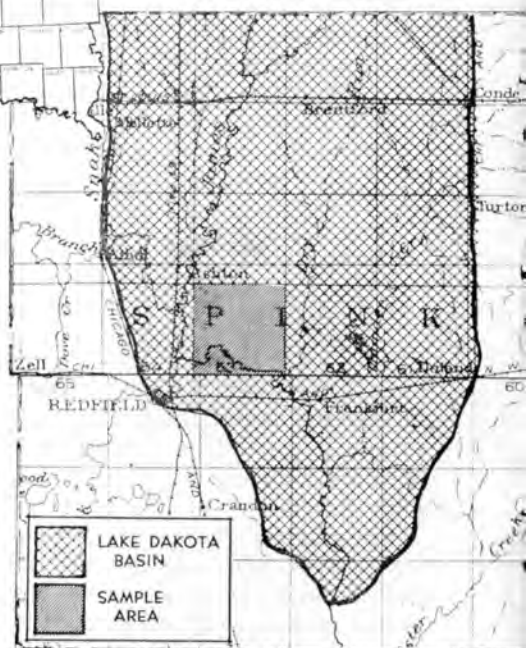
(Continued on Page 100)



Left: The original Oahe area, showing where the new irrigation project will be. Center: Spink County, South Dakota, showing location of Lake Dakota Basin. Lower right: A soil scientist using a permeability rack to measure how much water comes through the soil in a certain period of time. Soil samples are taken in brass cylinders and water is made up to simulate the composition of Missouri River water with the same salt content.

Soils Surveyed for Irrigation in Spink County

By F. C. WESTIN



THE SUCCESS of the Oahe irrigation project, or any other irrigation project, depends ultimately on two things—how well-adapted the soils are for irrigation and how successfully the good soils can be kept in a favorable condition under irrigation. The basic soil survey being conducted in Spink County by the South Dakota Experiment Station, cooperating with the United States Department of Agriculture, will assess the adaptability of Spink County soils for irrigation as well as answer some of the needs of dry land farmers.

However, the problem of successfully maintaining the soils in a favorable condition is much more difficult

to deal with. It involves, among other things, keeping a favorable calcium saturation in the soils and preventing an unfavorable sodium saturation from developing.

Calcium or Sodium—It Makes a Difference

The amount of calcium or sodium present is extremely important in managing soils especially if they are under irrigation. If the calcium content of the soil is high the clay acts as a glue and binds the soil particles together as granules. This imparts a favorable physical condition to the soil allowing free passage of water, air and plant roots. When the clay plates are

saturated with sodium, however, the opposite effect is achieved. The clay no longer acts as a glue, and the clay particles slide easily over one another, causing breakdown of the soil granules with loss of good physical condition. The soil no longer affords free passage to water, air and plant roots. This process takes place rapidly in soils having sodium-saturated clays if these soils are cultivated or disturbed when wet. It also takes place naturally as a soil-forming process, and is responsible for the fairly common claypan soils developed in the Oahe area.

The soil survey of Spink County separates soils where this process (called solonization) has already taken place from soils not yet affected. One of the most important soil management practices in Oahe, if and when irrigation comes, will be the

prevention of solonization by maintaining in the soils a calcium saturation and by preventing a sodium saturation from developing.

Sodium saturation may develop in soils in three principal ways: by accumulation of sodium carried in by the irrigation water, by raising of the water table, or by rise of dissolved sodium through the soil by capillary action (rise of a liquid similar to the rise of kerosene in a wick). The capillary water itself evaporates leaving a concentration of sodium in the soil.

Fortunately it appears that the Missouri River water anticipated for use on the Oahe project will not result in a harmful accumulation of sodium. Preventing a sodium accumulation from developing due to capillary rise or water table elevation appears to be a problem of considerable magnitude, however. Solving it will involve establishment of an adequate drainage system for the project.

Soils of Oahe Are Variable

A large part of Spink County is located within the Oahe area. (See map, page 92.) The Experiment Station and its cooperating USDA agencies have covered approximately 300,000 acres in the basic soil survey of Spink County. Most of this surveying has been in the so-called Lake Dakota basin (See map, page 92) and a smaller part in the glacial till plain. Four of the Lake Dakota basin soils will illustrate most of the soil problems encountered over the course of the survey. These four soils are: Bearden G₁, Abbe, Aberdeen, and Exline. They have all developed from the same parent material, (water deposited silts and very fine sands,) but different kinds of profiles have formed due to



the influence of topography and salt concentration.

Bearden has developed on gently undulating topography, has a deep mellow profile and no claypan. Abbe has formed on almost level topography, is deep and has a slight claypan. Aberdeen has developed on level topography, has a moderately hard claypan, and Exline has developed on level depressional topography and has a very hard claypan.

Permeability studies on these soil profiles, or studies showing the ability of soils to permit passage of water, indicate that the Exline claypan is impermeable (not permitting passage) while the claypans of Abbe and Aberdeen are moderately permeable. The Bearden profile is also permeable. Permeability studies on the parent materials (lake-laid silts and clays) for these soils show a low degree of permeability.

The amounts of total clay (particles less than .002 millimeters) for these four soils present in the B₂, or claypan, layer is shown in Table 1.

Table 1. Percent Clay in B₂ or Claypan Layer of Four Lake Dakota Basin Soils

	Bearden G ₁	Abbe	Aberdeen	Exline
Percent Clay	23.5	35.5	39.9	36.4

These data seem to conflict with the field appraisal of the degree of compaction (unfavorable condition of the soil which does not readily allow for the passage of air and water) in which Exline was the most compact, and also the most impermeable. Exline may actually have a smaller percentage of total clay than either Abbe or Aberdeen. The explanation for this apparent inconsistency can be found

in Table 2, which lists the percentages of sodium and calcium in these soils. It can be seen from this table that the Exline soil has an extremely high sodium content compared to the other three soils.

Table 2. Water Soluble Sodium and Calcium in B₂ or Claypan Layer of Four Lake Dakota Basin Soils (Milliequivalents per 100 grams)

	Bearden G ₁	Abbe	Aberdeen	Exline
Sodium	0.09	0.35	0.26	5.0
Calcium	0.31	0.20		5.95

From this it can be inferred that our field mapping units based on degree of compaction actually tell us what is the relative sodium saturation of the soil. Another conclusion which can be drawn from this, is *that the Abbe and Aberdeen soils and possibly the Bearden soils are potential Exline soils. If proper precautions to prevent sodium saturation are not taken, some of the best soils in the Lake Dakota basin in Oahe can be changed to non-irrigable soils in a matter of a few years.*

Percent of Irrigable Land Classified

The results of mapping have not been completely tabulated as yet to show the actual percentages of the various classes of land. However, preliminary work on a typical township in Lake Dakota basin. (See map) showed the following classes of soil.

Table 3. Soil Classes in T117N R63W Spink County, South Dakota

	percent		percent
Class I	.5	Class IV	32.0
Class II	10.5	Class VI	32.0
Class III	25.0		

The word "soil" used in the term "soil classes" in Table 3 means soil in its broad sense, that is, the natural landscape. This however does not in-

(Continued on page 100)

7 Plan to pass ownership to own generation



8 No plans except to divide land equally among heirs



13 Plan to pass ownership to next generation



51 No plans at all



EACH  = 3 FARMERS

Transferring THE FARM WITHIN THE FAMILY

Seventy-nine South Dakota landowners. What will become of their farms?

By MAX MYERS

I HAVEN'T THOUGHT about it ... but maybe I should!"

That was the most common reply when almost two hundred farm families were asked about the disposition of their farms. Entirely too many farm owners—most of them in fact—die before they get around to making a decision as to who gets the farm. The families, the farms, and the public will benefit if farm transfer arrangements are made more carefully and sooner.

Many farmers want to keep their farms in their own families for future generations. There are sound reasons to support this desire for those on adequate and efficient farm units. One of these reasons is that a farm transferred within the family can more eas-

ily be transferred as a "going concern."

One has only to look around the average farming neighborhood to realize that relatively few farms stay in the same family for successive generations, and that even fewer farms are transferred as complete, operating businesses. Generally the retiring farmer sells his stock and equipment at public auction, takes his valuable management knowledge off the farm and lets a new operator learn by trial and error.

Specific evidence as to the ways in which South Dakota farmers acquire and dispose of land was gathered during 1947-48 from a study of the tenure histories of 144 families who have operated or owned 130 farms in South Dakota counties. Of these, 107 owned, or had owned, land, but only 20

owned land which had been acquired by an earlier generation of the same family.

Ninety-one percent of the acreage acquired was obtained from non-relatives. Inheritance clearly played a small part.

There are numerous reasons why farms do not stay "in the family." These include the lack of heirs, or the unwillingness of heirs to farm, inadequate size of farm business, lack of capital and reluctance to discuss the disposition of property or to take any action until after the death of the owner. However, there are many families which have a suitable business which they wish to transfer to the next generation. What can they do about it?

Points to Consider

No two farm family situations are exactly alike. Therefore no one definite plan can be laid down for use by all farm owners. The study of many farm family situations and the experience of many South Dakota attorneys, as brought together in this report, seem to indicate that the following points are important:

A. It is rather generally believed that there are benefits to individuals, families, communities, and the public if successful farm businesses are handed down as going concerns through the right kind of farm families.

B. Some farms probably should not be kept in the family. Unless the business is adequate in size and efficiency to support a family and sometimes two families, there is little reason to make the effort necessary to keep one of the children on it.

C. If a given farm business is adequate and if it is desired to keep it in the family, then the next question is

that of deciding who is willing and able to take over from the present owner. For families with children this may raise the problem of creating in at least one of them an interest in farming and in continuation of the home farm business. This interest cannot be created overnight just when the parents wish to retire. It is something that starts in childhood, possibly with small shares in farming such as 4-H and F.F.A. projects, and the continuation of such interest is frequently tied to an understanding by the young man or woman of how the home farm is to be passed on and to whom.

D. The family should be able to discuss future plans for the farm business and the eventual disposition of the property, to discuss this sensibly and with a realization that different members have different interests. This should be done early. Some decisions should be made before all the children choose other paths and leave home. It seems preferable that these decisions and the necessary legal arrangements be made long before the parents expect to leave this world or even to retire. This does not necessarily mean that title to property has to be transferred early, but some definite plans should be made. Such planning and action can forestall friction and uncertainty within the family. It can take into account the effects of taxation and make it possible to avoid losses to the family or the farm and unnecessary expenses to the future estate.

E. There are various alternative methods or legal devices which can be employed to put the family's plans into effect. These devices differ and are suited to different situations.

Legal Ways of Transferring Farm Ownership

The principal alternatives which lie before the farm owner who is considering the disposition of his property are these:

1. *The laws of inheritance* (or descent)—The owner may make no disposition or plans. After he dies intestate (without a will) the courts will make disposition of the property to the heirs.

2. *A will*—He may bequeath the property in a will, and specify who gets what and on what terms.

3. *Joint tenancy*—He may hold the property in joint tenancy with right of survivorship so that when he dies the property will pass to the other person or persons named in the title.

4. *Gifts of property*—He may give his farm away before he dies, or he may give future title but retain life use of it.

5. *Sales of property*—He may sell the farm, either outright or with various restrictions.

6. *Incorporation*—He may incorporate the farm business, and then dispose of shares in the corporation by methods listed above.

Many Interests to be Reconciled

Several sets of interests must be reconciled in order to accomplish a successful family transfer of a farm business. These interests include:

1. The needs of the parents (landholders) for security of income as long as either lives. This is particularly important when the farm is their only property.

2. The desire of the young man and his family for security of expectation, that is, the certainty that they will own the farm if they work on it and improve it.

3. The interests of other heirs in the family, who under the American way of doing things, expect to receive equal or equitable treatment.

4. The interests of the farm, which should not be deteriorated in the process of farming or of transferring the farm. The community and the general public also have an indirect interest in the farm—an interest in efficient, continuous production of foods.

The importance of each of these interests will vary from family to family and from time to time. The problem, then, is to select arrangements which will fit the particular combination of circumstances in the individual case.

It is difficult to rank one method as better than others, but certain generalizations can be made. For the farm owner who must depend on the income from the farm as long as he lives, the disposition by means of a will is probably most suitable. In situations where it is more important to give the next generation certainty that they will get the farm, it is probably most satisfactory to sell the farm to them when the owner is ready to retire. However, in both these situations a case can be made for the use of a deed with a retained life interest to the parents. The land owner should decide what he wants to do.

A matter as important as the arrangements for transfer of farm property should never be undertaken without competent legal advice and assistance. A lawyer can advise the farm owner as to the effect of various plans and methods on the farmer's particular situation. Once the owner has decided what he wants to do the attorney can tell him how to do it legally. (Project 166, Agricultural Economics.)



Sprinkler

To Obtain Uniformity In Areas of P

By JOHN L. WIERSMA

SPRINKLER IRRIGATION was developed in an area where average wind velocities are 2 miles per hour or less and the maximum velocity seldom exceeds 4 miles per hour. Standard designs are based on this figure. In South Dakota the average wind velocity is between 10 and 11 miles per hour with maximum velocities much greater than this. Therefore, our sprinkler designs must be modified to compensate for this difference.

Common methods of getting a more uniform water coverage to compensate for the wind distortion are to use increased riser pressure, closer spacing of the sprinklers on the line and shorter moves between lines, larger nozzles, and special type heads.

Increasing Water Pressure Improves Distribution

Increasing the water pressure will improve the water distribution. The maximum usable pressure will be limited by the pump operating cost and will not be determined by the uniformity of the water distribution. Higher pressures will increase pumping cost considerably. However, in a 10 mile-per-hour wind a riser pressure of 50 pounds per square inch will re-

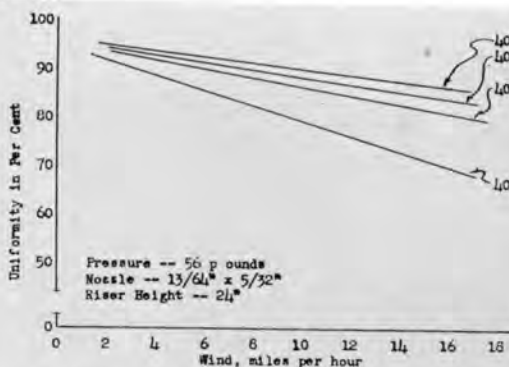


Figure 1. Uniformity for Various Spacings

sult in about 10 percent better pattern than a pressure of 40 pounds per square inch. A pressure increase from 50 pounds to 60 pounds per square inch will increase the uniformity only about 5 percent.

Spacing of Sprinkler Heads Tested

Closer spacing of the sprinkler heads on the line and shorter moves between lines will also aid in more uniform water application. Labor costs will be increased if the move between lines is decreased. The expected uniformity for various moves is illustrated in Fig. 1. It is noted that there is little difference in a 30-foot, 40-foot and a 50-foot move in a 10 mile-per-hour wind. However, there is a considerable difference between a 50-foot move and a 60-foot move. The tests for determining these lines were run

Irrigation

Water Distribution and Velocities

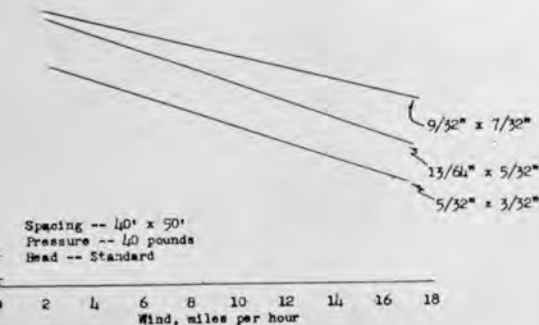


Figure 2. Uniformity for Different Size Nozzles

using a medium weight sprinkler head mounted on a 24-inch riser. The nozzles used applied 13 gallons of water per minute, at 56 pounds pressure.

A sprinkler head from which the spreader nozzle has been removed and replaced with a plug and only the range nozzle is used will also aid in obtaining more even water distribution during winds of 8 miles per hour or greater. The top line in Fig. 3 represents the expected uniformity for a spacing of 20 feet between sprinklers and a 50-foot move between lines. It is noted that other type heads and nozzles are superior for lower wind velocities.

Large Nozzle More Efficient

The size of nozzles used will also affect the distribution. The type soil,

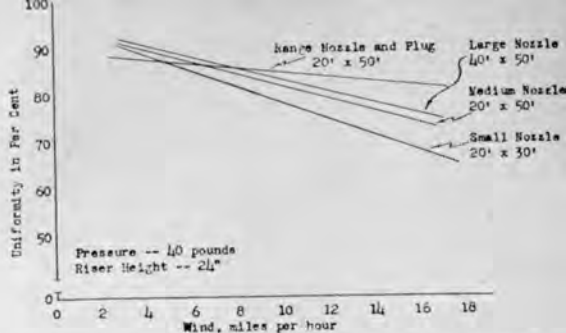


Figure 3. Comparison of Uniformity for Equal Precipitation Rate

work schedule, and the rate at which the water is available will usually determine the nozzle size that can be used, but if a choice can be made, the larger nozzle will help to obtain more uniform water distribution. In Fig. 2 conditions were identical with the exception of the size of nozzle used. The large nozzle would apply about 21 gallons of water per minute,

which is equal to a precipitation rate of about one inch per hour when spaced 40 feet between sprinklers and moved 50 feet. The medium size nozzle would apply about 13 gallons of water per minute, which is equal to 0.6 of an inch of water per minute with the same spacing, and the small nozzle will apply about 6.5 gallons per minute which is equal to 0.3 inches of precipitation per hour. It is noted from Fig. 2 that for low wind velocities there is little difference, but as the wind velocity increases the difference becomes more noticeable. The larger nozzle is superior to the small nozzle.

Type of Nozzle Head Makes a Difference

Figure 3 shows a comparison for different nozzles and spacings in

which the precipitation rates are approximately equal. The pumping costs would be identical because the same pressure was used throughout the entire comparison. For winds of 8 miles per hour or greater the head with only a range nozzle and a plug in the spreader nozzle, spaced 20 feet on the line, is superior to any other in this comparison. The labor costs for these three comparisons would be identical. A small nozzle placed 20 feet apart on the line and moved 30 feet between moves is not as good as the larger nozzles with greater spacing. There would be twice as much labor involved in doing this. A large nozzle spaced 40 feet between heads

and moved 50 feet will give about an identical pattern as a medium-size nozzle placed 20 feet on the line and moved 50 feet between moves. The latter method would be more expensive because twice as many sprinkler heads would be required per line.

In determining a suitably designed sprinkler irrigation system, all factors such as available labor, pumping costs, maximum allowable precipitation rate, location of the system, and type of crop grown must be given consideration before the desired uniformity of water application can be attained. (Project 192, Agricultural Engineering Department.)

(Harvesting Hay, Continued from page 89)

Technique Improved

A by-product of these studies which is of more interest and value from a technical standpoint than from a popular standpoint was a comparison of 7-day collection periods versus 10-day collection periods in determining digestion coefficients. The 10-day period is most commonly employed. A study involving 27 comparisons in which double feces samples were collected over 7 and 10 day periods and analyzed, showed the loss in efficiency when 7-day periods were used rather than 10-day periods was very small except for nitrogen-free extract.

Except for nitrogen-free extract, none of the other efficiency losses (computed from digestion coefficients) reached 2 percent. On the basis of these findings the shorter period is being used for the 1950 trials. (Project 120. Leaders: George Staples, R. M. Jordan, Animal Husbandry Department; A. L. Moxon, Chemistry Department; J. G. Ross, Agronomy.)

(Soils, Continued from page 94)

clude an item such as overall drainage.

Class I soil is that ideally suited for irrigation at the time of the survey. It occurs on a favorable slope, has no clay pan or other impermeable layer, is low in sodium and other harmful salts, has a deep profile and is not stony. Class II soil is less suited for irrigation than Class I. This may be due to less favorable conditions of slope, permeability, sodium, depth of soil, or stoniness. Class III soil is again less favorable than II. Class IV soil is considered as being suitable only for irrigated pasture and Class VI is unsuitable for any kind of irrigation.

Thus from this sample area, and from the basis of soils alone, 36 percent of the soil falls into one of the first three classes which are considered as being irrigable, while 32 percent appears suitable only for pasture and 32 percent seems unsuitable for any type of irrigation. (Project 183, Leaders: F. C. Westin, A. J. Klingelhoets, G. B. Lee, W. Moldenhauer, D. Kettering, Agronomy Department.)

Annual Report

supplementing the quarterly reports

of the

South Dakota Farm and Home Research

for the year ending

June 30, 1950

MAJOR PROJECTS in research for many of the departments have been reported on in the forepart of this Annual Report. They will be listed here under the proper subject and a page reference given so the entire accomplishments of the Station in any one field will be apparent under a single heading.

Crops and Soils

Good Soil Management Practices Pay in a Dry Year

For South Dakota the most important soil fertility problem is the maintenance of soil organic matter and nitrogen. The effects of soil treatments, especially rotations, crop residues and tillage on the nitrogen and organic matter balance of the soil is emphasized. The work is carried out on the Agronomy Farm and on outlying field plots.

Changes in nitrogen and organic matter as influenced by soil treatment were as follows: In a corn-oats-wheat rotation (1942-48), with tillage by plowing and crop residue removed, the surface soil lost 544 pounds of nitrogen and 8600 pounds organic matter. In the same rotation with crop residues returned, the soil lost 202 pounds of nitrogen and 2940 pounds of organic matter per acre in surface soil.

Results from the rotation and fertilizer plots showed that well-nourished

crops with respect to nitrogen and phosphorus are more able to withstand and recover from the effects of drought, and therefore make the highest yields. For example, wheat yields averaged 20 bushels per acre where the soil nitrogen and organic matter was well maintained in a sweetclover-corn-wheat rotation. In a corn-oats-wheat rotation, crop residue removed, wheat yields averaged only 9.5 bushels per acre. In the same rotation where all crop residues were returned, the wheat yields averaged 13 bushels per acre.

Corn yields were much influenced in 1949 by the method used to prepare the seed bed. Subsurface tilled plots gave the largest yields of corn. Where all the crop residues were returned, the corn yielded 19 bushels per acre under plowing and 37 bushels per acre under subsurface tillage. The corn on the subsurface tilled plots was not as tall as the corn plants on the plowed plots. For this reason the

corn on the subsurface tilled plots appeared to have been more able to withstand the effects of the summer drought and therefore made the highest yield. (Project 46. Leaders: L. F. Puhr and W. W. Worzella, Agronomy Department.)

Good Soil Management Practices Increase Yield at Cottonwood

Rotation, fertilizer and tillage experiments at the Cottonwood Field Station in 1949 indicated considerably higher yields of wheat may be obtained after sorghum or fallow than after oats. Ammonium nitrate fertilizer applied at 15 pounds of nitrogen per acre increased barley yields by 3 bushels per acre. Subsurface tillage of sorghum land resulted in about 3½ bushels higher wheat yields than did plowing of sorghum stubble. Six-inch and 12-inch drill row spacings were compared with all soil treatments on both wheat and barley. There was a slight advantage for wheat with 12-inch spacing on fallow or sorghum land, but a decided advantage in favor of 6-inch spacing with wheat on oat stubble land. (Project 4. Leader: L. O. Fine, Agronomy Department. Carl B. Larsen, Supt. Range Field Station, Cottonwood.)

Soil Sampling, See page 15

Soil Survey, Spink County, See page 92

Irrigation, Redfield Soil Studies, See page 34

New Corn Hybrid Excels in Yielding Ability and Appearance

As a result of the work conducted on corn breeding, it was possible to release to farmers one new South Dakota hybrid early in 1950. This hybrid has been designated South Dakota 270. It is slightly later than South Dakota 224, being about 95-100 days in maturity. It will outyield 224 and will far excel it in appearance.

South Dakota 270 is composed of two South Dakota inbreds and two out-state

inbreds, thus illustrating the importance of obtaining lines from other stations. Forty to fifty such inbreds are maintained in the breeding nursery.

In order to develop new hybrids several thousand hand pollinations are made each year. This is to maintain old lines and to develop new ones. In developing new inbreds, open-pollinated varieties are being used as source material, as well as double crosses, F₁'s and backcrosses. Also, several second-cycle or recovered inbreds now being developed show considerable promise.

After experimental hybrids are made, it is necessary to test them to see if they have any value. In 1949, nine yield tests on experimental double crosses and six on single crosses (for prediction purposes) were completed. These fell into four maturity groups. Several combinations were good under climatic conditions as they existed last year. (Project 66. Leader: D. B. Shank, Agronomy Department.)

Popular Corn Hybrids Tested As a Service

One of the services which South Dakota State College performs is the testing of commercial corn hybrids in yield trials each year so as to be able to supply farmers with information on the particular hybrids tested. In 1949, ten such trials were put out with at least one being located in each of the eight agricultural districts in the state. Seven were harvested, the other three being lost because of adverse climatic conditions. The ones completed were located near Spearfish, Eureka, Claremont, Brookings, Mitchell, Garretson, and Vermillion.

Information secured consisted of yield and percent moisture in the grain at the time of harvest. In the published report, average yields for a period of years are also given. The results have been published in Circular 79, entitled "1949 South Dakota Corn Performance Tests." (Project 151. Leaders: D. B.

Shank and Glen Nachtigal, Agronomy Department.)

Oats, James Hulless, See page 49

Developing Grain Sorghums That Germinate in Cold Soil

Sixty-two strains of grain sorghum were placed in a cold chamber for 14 days at 45° F. before being taken out and placed at room temperature for emergence. The results showed that the strains varied in emergence from 0 to 66 percent. A high correlation was found between the results of the past two years, which may indicate that it is possible to select and breed grain sorghums that can be planted earlier in cold wet soils. This will aid considerably in producing matured grain of a high quality which will keep better in storage. It also will make harvesting the grain crop come early in the fall during the better drying weather, thereby producing grain with a lower moisture content before it is placed in storage. These are very important factors for the keeping qualities of grain sorghum when placed in storage. (Project 112. Leader: C. J. Franzke, Agronomy Department.)

Sorghum, Norghum, See page 1

New Legumes Developed for Our Climate

Following a year's observations of some 5,000 naturalized hybrid plants in a hybrid population initially established at Brookings in 1915, 80 plants of alfalfa were selected in October 1949 for transfer to the greenhouse for further work. These were arranged into mating groups on the basis of type classification, i.e., pasture, hay, or dual type, and all combination crosses made within each group. Twelve such groups, comprising over 700 single crosses were worked with, and both selfed and crossed progenies established in the field in June 1950.

An additional 66 plant selections were

secured from the hybrid field located near Bison, South Dakota, and self progenies established from most of these in June 1950. Special breeding stocks have been obtained from other experiment station workers, from the United States Department of Agriculture, from foreign introductions, and from Canadian workers. Selections are to be made from this material (on basis of disease resistance, in most instances) for combination with our own type selections. Agronomic data have been secured on standard and new varieties of alfalfa.

Sweetclover Under Test

Seed increases of certain large-seeded species of sweetclover were secured by hand-selling in the greenhouse. Further increase and some crosses with the adapted small-seeded forms are planned for these species. Approximately 45 strains from the USDA and Canadian workers have been assembled for test here. (Project 74. Leaders: M. W. Adams, W. W. Worzella, Agronomy Department.)

Birdsfoot Trefoil Treated For Cold Resistance

Open-pollinated seed stocks of 22 selections were subjected to a preliminary test for cold resistance in December 1949. Eight lines were found to be superior enough to warrant further experimentation.

Thousands of Grass Strains Tested in Breeding Program

Eight thousand plants of brome grass, Ree wheatgrass and crested wheatgrass were started in the greenhouse and transplanted into the field in May. These consisted of progenies of plants selected on the basis of appearances, and also seed collections from old fields in the state.

Forage yields were taken from brome grass strains tests and other forage tests at Brookings, Highmore, Eureka and Cottonwood. The superiority of native

strains of brome grass was again demonstrated and it was decided to composite the best of these to form a South Dakota source. Mixtures of brome grass and alfalfa again proved their superiority over brome grass alone.

Controlled pollinations of superior plants of brome grass, Ree wheat grass and crested wheat grass were carried out both in the field and in the greenhouse to determine desirable combinations from which further selection might be made. Preliminary studies of the heritability of seed and forage production in brome grass indicate a comparatively high value for the seed and a very low value for the forage. There would appear to be no selection pressure exerted against forage production by selection for high seed production. Methods of increasing seed production in grasses are being studied.

Cytological examination of grass clones used in forming strains is being made. The possibility of making crosses between rye and Russian Wild Rye and, in addition, back crosses of wheat grass hybrids to wheat grass were investigated. A cytogenetic study of accessory chromosomes in brome grass is being continued. (Project 182. Leaders: J. G. Ross and W. W. Worzella, Agronomy Department.)

New Soybeans Tested for Maturity

In cooperation with the Regional Soybean Laboratory located at Urbana, Illinois, and aided by farmer-cooperators in Roberts and Clay counties, the Experiment Station has conducted variety and strain tests of soybeans in three maturity groups, the very early, the early, and the mid-season. Previously about 15 to 20 entries comprised each test. In 1950, the entries numbered 18 for the very early, 18 for the early, and 20 for the mid-season group. Each entry is grown in four replications and scored for yield, maturity, lodging, height, seed quality, seed size, and shattering.

Chemical determinations for percent oil and protein are made at the Regional Laboratory. Since 1947 through participation in the Regional Testing Program, the Experiment Station has engaged in foundation seed increase and release of three improved varieties of soybeans, one each for the three maturity zones of the South Dakota soybean area. These releases have added and will continue to add stability and increased income to the soybean grower in this state. (Project 148. Leader: M. W. Adams, Agronomy Department.)

Weed Control, See page 46

Agricultural Chemistry

Variation in Protein Content of Barley Varieties Studied

The importance of barley as a crop in South Dakota is attested by the fact that our state ranks second in barley production. Our farmers produce about 32,000,000 bushels of barley annually.

While neighboring eastern states find a ready market for much of their barley at premium malting prices, our farmers are generally forced to sell their malting type barleys at reduced rates comparable to feeding grade prices. The reason for the frequent price discrepancy toward

barley from South Dakota as compared to other states is not altogether apparent. That Minnesota and Wisconsin have established malting varieties and areas of known reputation is evident. On the other hand, our most suitable barley varieties are largely the result of recent breeding work.

The problem thus resolves itself as one for determining the adequacy of our new barley varieties for malting and also feeding purposes. The farmer will profit if some means can be found to evaluate both malting and feeding barley varieties



Station chemists measuring the poisonous effects of selenium in animal tissue. Use of arsenic in salt when fed to farm animals is still the only practical way to alleviate effects of selenium poisoning.

in different areas of the state. The successful termination of the study would thus eliminate the present excessive production of substandard malting type barley. Such barley, when rejected for malting, must be used for feeding in spite of the disadvantage of its usual low protein content. Thus, it is obvious that high protein barley varieties suitable for feeding may well be the logical barley varieties for many areas of the state.

The Station Chemistry department, in cooperation with the Agronomy department, is studying the variation in protein composition of different barley varieties. The protein content of barley is the primary constituent affecting malting as well as nutritive quality of barley. The preliminary observations which are shown in the table indicate definite differences in protein composition between different varieties (see hordein and glutelin). Future studies will evaluate

protein variations within a variety when grown in different areas of the state.

Protein Distribution in Different Barley Varieties

	Odessa ¹ %	Feebar ² %	Plains ³ %
Albumin	0.66	0.69	0.73
Globulin	1.40	1.63	1.40
Protease	0.98	0.93	0.87
Non-Protein nitrogen ⁴	0.65	0.66	0.56
Hordein	3.96	5.14	4.57
Glutelin	6.58	6.80	5.96
Total protein ⁵	14.23	15.85	14.09

¹Odessa—A standard malting variety for neighboring eastern states but not well adapted to most South Dakota areas.

²Feebar—A new high protein feeding barley well adapted to South Dakota.

³Plains—A new medium protein barley adapted to South Dakota. (This barley seems suitable for malting requirements but the malting companies are reluctant to use it.)

⁴Calculated as protein.

⁵Conversion Factor 6.25 employed for all protein calculations.

A purified sample of one of the major protein constituents of barley (hordein) has been prepared. The nutritive quality

of this protein will be studied by estimation of the hydrolysis products obtained after treatment with digestive extracts (pancreatic and intestinal enzymes). It is hoped to find some explanation for the extremely low nutritional value of cereal (Prolamines) proteins. Cereal proteins are the most abundant, yet the poorest in nutritive quality of all available proteins. Thus, any study aimed at improvement of cereal protein quality is of paramount importance. (Project 195. Leaders: A. W. Halverson, A. L. Moxon, Station Chemistry, and J. E. Grafius, Agronomy.)

Minerals and Trace Elements Tested in Feeds and Water Supplies

Samples of grasses were collected for the second year from Roberts and Marshall counties. These samples do not show a generalized low phosphorus for the entire area as has been reported for the adjacent area in Minnesota. The samples do, however, indicate a great variation in phosphorus content between plots in adjacent townships. It is possible that the plots which show a low phosphorus content can be correlated with certain (Pleistocene) glacial deposits.

Grasses and other roughages which have been analyzed from various locations within the state indicate that the range area, in general, produces roughages which are low in phosphorus. Cattle and sheep which are fed mostly on roughages should be given a supplementary source of phosphorus such as bone-meal or some other suitable mineral which will supply a similar ratio of phosphorus to calcium.

Iodine determinations have been made on a few samples but the method

of analysis for iodine needs refining before reliable values can be obtained on roughage materials. (Project No. 180. Leaders: A. L. Moxon, E. I. Whitehead, G. F. Gastler and A. W. Halverson, Station Chemistry Department.)

Treatment of Hard Water for Household, Farm and Dairy Use

Water used for cleansing purposes must be soft for most satisfactory results. In South Dakota the water supply is, for the most part, excessively hard. This presents a serious problem in laundering, and in cleansing of dairy and household equipment.

In an effort to find an answer to this problem equipment has been assembled and preliminary tests have been tried on fabric which has been uniformly soiled. Various soaps, synthetic detergents and softening agents have been tried in various combinations with moderately hard water. In all cases the cleansing action was poor when compared with the same cleansing agent in softened (base exchange process) water. The study will be extended to include stainless steel aluminum and other materials commonly used for dairy and household equipment. (Project 193. Leaders: A. L. Moxon, G. F. Gastler, Station Chemistry Department; D. F. Breazeale, Dairy Department; Lillian Lund, Home Economics Department.)

Corn Plants, Chemical Composition, See pg. 127

Nitrate Poisoning, See page 3

Selenium Poisoning, See page 126

Harvesting Prairie Hay, See page 88

Crop Insects

Corn Borer Control, See page 62

Grasshoppers, 1950, See page 57

Heel Fly and Cattle Grub Control, See page 43

Insects, Mites and Ticks, See page 125



Student assistants helping with apricot-crossing by doing hand pollinations. Pollen is collected from tubbed plants and from experiment stations in other states and kept under refrigeration until used.

Fruits and Vegetables

Vegetable Yields and Quality

Obtaining a good yield from a vegetable is frequently the main objective of the grower. To obtain high quality over a long period of time is just as frequently overlooked. Determining cultural practices that will give the grower the most high quality vegetables has been the objective of a vegetable study at this Station. The value of transplanting seedlings as compared to direct seeding, the age of the seedling going to the field, the degree of hardening necessary, the influence of fertilizer and the benefit of irrigation have all been studied. Preliminary results indicate that for most vegetables, earliness, quality of product and yield are practices now overlooked by the grower. (Project 118. Leader: S. A. McCrory, Horticulture Department.)

Promising Sweet Corn Hybrids Selected

Most sweet corn now grown commercially, as well as that grown in home gardens, is a first-generation hybrid. This hybrid is a cross of two inbred lines whose characters have been fixed by years of inbreeding. Many inbred crosses are necessary in order to determine the ability of a line to produce superior hybrids.

Many promising lines have been selected and their hybrids are being evaluated. One line known as 176 is a Bantam type which offers much promise. It is one of the most vigorous, produces a good quality hybrid in many combinations, possesses some degree of resistance to smut and produces a good supply of pollen. Line 226 is a very early line. High

quality and earliness generally show little positive correlation. However, line 226 gives a good quality hybrid for an early sweet corn. Many others have also been selected.

A succession of high quality hybrids is needed by both the home and commercial grower. The sweet corn breeding program under way at this Station has developed the inbred lines to do this. One is now being increased for release next year. Others will follow as quickly as they can be increased. (Project 68. Leader: S. A. McCrory, Horticulture Department.)

New Fruit Varieties Named

A fruit breeding project was started at the South Dakota Experiment Station in 1895. Since that time many winter-hardy fruit plants have been collected from both foreign and native sources. Hybridization of these with high quality varieties has been the method of improvement.

In 1949 many seedling apples fruited for the first time. Sixty-eight of these were selected and given a number for further observation. A new apricot selection of the hardy Siberian type was named Sunshine. Also a sandcherry-plum hybrid was named Honeydew. Growing seedling plants to a bearing age is a long time project. Apples, apricots, plums, cherries and pears are receiving attention under this project. (Project 1. Leader: S. A. McCrory, Horticulture Department.)

Genetic Stock to be Combined with High Quality Apples

The main work in connection with this project the past year has been the relocation of genetic stocks used in the development of Triploid apples. To date the apples that have been developed as a result of this project have been promising only as genetic stock. For testing, it is planned to combine these with high quality apples. (Project 59. Leader: N. E. Hansen, Horticulture Department.)

Collecting, Preserving, Cataloguing, Propagating and Testing of Fruit Plants Having Genetic Value

The Department of Horticulture has a collection of fruit plants, many from foreign sources, which may have genetic value. This project was started with the objective of arranging in a systematic order all of this collection and to give a preliminary evaluation to them.

The work of cataloguing is largely completed. Evaluating three apple root stocks is under way. The Manchu crab is producing a semi-dwarf tree and may have some merit as a root stock. The selection called Yellow Siberian crab is producing a large tree with up-right growth habit.

A collection of 20 varieties of apples from Russia, which were rated as their leading varieties, were planted for observation. They and the other plants are located in a foundation planting to be maintained for observation and study. This material will be used in the fruit breeding work as well as be made available to other experiment stations. (RMA Project 174. Leader: S. A. McCrory, Horticulture Department.)

Hybrid Elms Considered For Use in Shelterbelts

The purpose of this project has been to study new varieties and species of trees and shrubs for the shelterbelts of South Dakota. The breeding of superior types has received little attention, but superior strains and chance hybrids are available.

Most nurseries in this region list hybrid elms; in some cases they are said to be crosses of American and Chinese elms, others of slippery (red) elm and Chinese elms. Crosses among these species may occur naturally, for all of these trees bloom about the same time in early spring. According to Mr. E. C. George of the Field Station at Mandan, North Dakota, who worked on controlled crosses, these are seedlings of Chinese and slippery elm. The American elm

crossed with Chinese elm failed to set seed.

Many of the trees listed are simply selections of unusual chance seedlings found in nursery rows. Any outstanding tree may be propagated by grafting or budding so that all the resulting plants are the same as the selected specimen. The price of the resulting trees is then much higher than the seedling stock sold for shelterbelt or shade tree planting.

Observations have been made for a number of years on trees raised from the seed of slippery elm grown near Chinese

elm. The seed, when sown, develops into hybrid elms which resemble the Chinese elms in many ways, but are stronger, faster growing trees.

A superior early-maturing strain of Chinese elm, the Harbin, has been tested and a planting made in 1950 to obtain a good seed source for nurserymen of the region. (Project 142. Leader: M. A. Maxon, Horticulture Department.)

Tomatoes, See page 55

Strawberries, Vitamin C, See page 61

Ponderosa Pine, See page 69

Plant Diseases

Search for Resistance to Foliage Diseases of Tomatoes

Further trials with various fungicides for the control of foliage diseases of tomatoes were conducted in 1949. The treatments included tribasic copper sulphate, dithane z-78, cop-o-zinc, zerlate, yellow-cuprocide, phygon, methasan paste, zerlate alternating with tribasic copper sulphate, and check. Four applications were made at 2-week intervals beginning July 6.

Owing to the dry season, yields were low, and foliage diseases developed only lightly. Significant increases in yield were obtained with tribasic copper sulphate, zerlate, and yellow cuprocide. A decrease in yield resulted from the use of phygon in 1949, although it produced favorable results in previous trials.

In the search for resistance to foliage diseases, particularly septoria leaf spot, 73 tomato lines, mostly crosses with wild species were grown in the field. Because of the light disease development in 1949, no selection for resistance was possible. Seed from each line was collected in the field and planted in the greenhouse during the winter. Over 7000 plants were artificially inoculated at the 5-leaf stage

with cultures of *Septoria lycopersici*. Twelve lines showed a high degree of resistance and will be used in future experiments. (Project 146. Leader: L. T. Richardson, Plant Pathology Department.)

Control of Potato Diseases Sought

Fungicide trials for the control of foliage diseases of potatoes were continued in 1949. The fungicides used included tribasic copper sulphate, dithane z-78, cop-o-zinc, zerlate, yellow cuprocide, phygon, crag 658 (copper zinc chromate), and Bordeaux mixture. DDT was used with each, and also on the check plots for insect control. Four applications were made at 2-week intervals beginning June 24.

No late blight and very little early blight developed on the foliage during 1949. All treatments reduced the amount of early blight as compared with the checks, but there was no significant difference between treatments. The differences in yield between treatments in this trial were not statistically significant.

Further selections were made on 30 scab-resistant potato lines grown in randomized blocks with 3 replications.



(1) hard red spring wheat (2) durum wheat and (3) winter wheat, showing healthy plants and plants infected with mosaic. Notice stunted growth and fewer number of heads on infected plants.

The type and degree of scab infection, foliage diseases, yields, and other characters of each line were observed. Twelve lines were discarded on the basis of their reaction to scab. All stocks reserved for further tests were eye-indexed in the greenhouse during the winter to eliminate virus diseases. (Project 107. Leader: L. T. Richardson, Plant Pathology Department.)

Mosaic Disease Found on Wheat in South Dakota

A disease called mosaic has recently been found infecting winter and spring wheat in certain areas of South Dakota. Although infection is so light in many of the fields that no noticeable losses will

be encountered in 1950, a number of other fields are so heavily infected that major losses in yield will result. The most seriously affected fields are in Bennett, Gregory, Lyman, Pennington, and Tripp counties, where in some instances, up to 80 percent of the plants are infected. Mild infections have been discovered in most areas in the southern half of the state wherever winter wheat is grown regularly.

The mosaic disease is caused by a virus. Plants may become infected at any time between emergence and heading, but they are most susceptible from the three-leaf to the jointing stage. The first symptoms are faint streaks or flecks in the young leaves. The streaks become

more pronounced and cover more of the leaf until, in severe cases, the entire leaf becomes yellow to white, and dies. When the plants are infected early, their growth is stunted and uneven. Some plants die prematurely, others mature without producing seed, and still others produce some seed which may be of a poor grade. If the plants are not infected until a later stage the symptoms will be milder and the damage to yield will be correspondingly less.

The exact method of spread is not yet known. Present indications are that infection spreads with the aid of insects, from infected green shoots and volunteer plants to the new winter wheat crop during early fall. The disease can overwinter in infected winter wheat, then during the late spring and summer it apparently spreads to other winter wheat plants and to spring wheat.

All of the currently grown varieties of winter and spring wheat tested are susceptible to mosaic. The spring wheats, especially the durums, are somewhat more susceptible than the winter varieties. Barley and oats can also become infected, but they are not seriously damaged.

Tests on 200 samples of wheat from western Asia have indicated that some of them carry a certain degree of resistance. There is hope that resistant varieties may eventually be developed, but this work will require considerable time. In the meantime several precautionary measures should be followed to help control this disease. It is advisable to avoid sowing winter wheat in a field that has just grown a crop infected with mosaic. Volunteer wheat plants should be destroyed by thorough cultivation before the next year's crop of winter wheat is sown in nearby fields. Late sowing of winter wheat is preferable to early sowing from the standpoint of mosaic control, but late sowing is not a good practice in some areas because of the danger of winter killing. Spring wheat, on the

other hand, has a better chance of escaping serious infection when sown early, and it should not be sown adjacent to severely infected winter wheat fields.

Two hundred samples of wheat from Turkey and India are being tested in an attempt to find new sources of resistance to leaf rust. Some of these samples have produced plants carrying considerable resistance to the races of leaf rust important in this area, but further tests will be necessary to determine their usefulness in developing improved varieties for South Dakota. (Project 204. Leader: John T. Slykhuus, Plant Pathology Department.)

Corn Selected for Resistance to Root Rot

Several hundred lines of corn selected for resistance to root rot were grown in experiments at Brookings, Renner, and Colome in 1949. Open-pollinated, inbred lines, single and double crosses and introductions from Guatemala were included. Approximately 50 percent of the lines were discarded at harvest time because of insufficient tolerance to root and stalk rot. The balance was planted in the field last spring for further selection.

Laboratory isolations of fungi from a severely damaged corn field near Renner indicated that perhaps additional experiments on these isolates will show them to be highly pathogenic. These cultures will be included in greenhouse trials on a large number of corn lines this winter.

Root and stalk rot caused much lodged corn in 1949. It was difficult to determine lodging as caused by the corn borer and that which was caused by disease unless the stalks were pulled and examined. Root rot continued to be the most prevalent disease on corn, however. Helminthosporium leaf blight and what appeared to be a new disease of the stalk was found to be on the increase. (Project 185. Leader: C. M. Nagel, Plant Pathology Department.)

Liquid Seed Treatment, See page 25

Shelterbelt Cottonwoods, See page 75



These yearlings were put on limited winter feeding for moderate gains and then finished on alfalfa-brome pasture. They were also given a supplement of grain throughout the grazing season.

Livestock Production

Improvement in Beef Cattle Through Better Breeding

The beef cattle breeding project is continuing by establishing lines to (1) develop selection techniques that will aid the commercial producer to make reasonable improvement in his herd and (2) to develop lines of high-producing beef cattle. The results of the past year's test show a wide spread between individual bulls in average daily gain, ranging from 1.71 pounds daily to 3.01 pounds daily. The following table shows the differences between sire groups:

(Project 167. Leaders: Richard O. Smith and Karl Rasmussen, Animal Husbandry Department.)

Using Roughage and Pasture to Produce Fat Yearlings

With the present trend of increasing the acreage in pasture and hay to conserve our soils, livestock producers must find ways to use such feed profitably. This experiment is designed to find an efficient method of utilizing a maximum of roughage for fattening steers under South Dakota conditions. Different win-

Production Data on Bull, and Steer and Heifer Progenies Tested in 1948-49

Sire No. Animals fed	601 Steers and heifers	23 Steers and heifers	23 Bulls	8 Bulls
Number of calves fed	6	10	3	5
Weight at start, lbs.	392	405	408	391
Days on feed	256	260	210	210
Average final weight, lbs.	927	915	937	813
Average daily gain, lbs.	2.07	1.97	2.52	2.01
Feed per 100 lbs. gain				
Corn and cob meal, lbs.	634.8	629.0	545.1*	545.1*
Soybean oil meal, lbs.	49.4	50.6	45.3	45.3
Alfalfa hay, lbs.	218.7	223.8	203.9	203.9

*Fed in the same lot.

Fattening Cattle on Pasture—1949

Summer grazing (1949)	Full-fed dry lot	Native grass fed 7/20 to market	Brome-alfalfa fed 7/20 to market	Brome-alfalfa fed 5/25 to market	Native grass fed 5/25 to market
Number of animals	12	9	9	9	9
Initial weight, lbs.	757.	651.	651.	650.	651.
Final weight, lbs.	926.	953.	956.	100.5	941.
Daily gain, lbs.	1.87	1.99	2.01	2.81	2.30
Feed per 100 lbs. gain					
Shelled corn, lbs.	706.9	467.3	501.3	542.6	593.9
Soybean oil meal, lbs.	53.1	33.0	32.9	18.8	22.9
Salt, lbs.	1.5*	1.5	1.1	0.9	1.5
Acres pasture†		.37	.18	.13	.31
Alfalfa hay, lbs.	265.4				
Brome hay, lbs.			17.1	8.2	
Feed cost per 100 lbs. gain	\$19.36	\$12.54	\$12.96	\$12.72	\$14.37
Carcass data					
Grade	11A 1B	6A 3B	7A 2B	9A	4A 5B
Selling price per 100 lbs.	\$25.25	\$25.64	\$25.17	\$26.51	\$26.13

*Includes salt, bonemeal, and limestone.

†Lots V and VIII used 10 acres and 8 acres of native grass respectively, Lots VI and VII used 5 and 4 acres of brome-alfalfa pasture respectively.

ter rations, deferred and full feeding on native grass and a brome-alfalfa mixture, are being used.

The first phase of this experiment compares wintering rations on four lots of calves. Three of these lots are re-divided in the spring into four lots placed on a summer grazing phase. The results of the 1949 summer grazing phase are given in the table above.

Results show that it is possible to put on the cheapest gains by limited winter feeding and then utilizing summer pastures. The full-fed, dry lot cattle made greatest profits per head only when a considerable premium in price was received. In 1947 greatest profits were obtained from the dry lot cattle, but, in 1948 and 1949, greatest profits resulted in feeding cattle on pasture. The dry lot cattle required about 60 bushels of corn to produce a 900-pound market steer, while equal weight steers were produced with 30 bushels of corn plus abundant amounts of roughage and pasture.

Another part of this experiment involved pasturing cattle on irrigated pas-

tures at the Bureau of Reclamation Huron Development Farm. The data obtained in 1949 are shown in the table on the next page.

These data show that high cash returns per acre can be obtained by converting grass to beef. (Project 164, Leader: William C. McCone, Animal Husbandry Department.)

Summer Grazing Rates and Systems of Wintering Beef Cattle for Best Long-time Results

The summer phase of this experiment is designed to determine the most desirable rate of stocking native ranges for maximum yield and greatest conservation. Three rates of stocking, namely 8 acres, 13 acres, and 18 acres per cow for a 7-month grazing season, have been used. The undesirability of the heavier rate of stocking showed up in the relatively dry summer of 1949 when it was necessary to remove cows from both the heavily grazed and medium grazed pastures before the end of the grazing season in order to save the cattle. For the

**Production Data of Irrigated and Non-irrigated Grass Land Harvested as Beef and Hay.
Huron Development Farm, 1949.**

	Non-irrigated p.-sures		Irrigated pastures	
	Native	Native and nitrogen	Alfalfa-brome	Huntley mixture
Beef Cattle Production Data				
Acres in pasture	13.0	13.1	8.35	6.24
Number yearling steers and heifers used	5	5	14-16	8-9
Average beginning weight, lbs.	535.6	538.0	534.4	537.4
Average final weight, lbs.	770.0	785.0	759.7	793.2
Gains per acre, lbs.	90.2	94.3	400.4	353.0
Acres per animal for 4 mo. grazing	2.60	2.62	.55	.71
Hay Production Data				
Yield per acre (tons)	.55	.72	4.60	2.75
Current Grass Treatment Production Costs				
Seed per acre	\$0.00	\$0.00	\$3.10	\$3.50
Fertilizer per acre	0.00	4.00	6.88	10.30
Irrigation and extra labor per acre	0.00	0.00	3.50	3.50
Returns per acre, exclusive of land rental, interest on investment, risks, and labor for harvesting hay and caring for cattle*				
Beef Cattle	\$18.04	\$14.86	\$66.60	\$53.30
Hay	8.25	6.80	69.32	32.20

*Native hay, \$15; tame hay, \$18; cattle gains at \$20.00 per 100 pounds; fertilizer and seed at current costs.

last three years cows on the heavily grazed pasture had an average loss in weight of 93 pounds, those on medium grazed pasture lost 34 pounds, while those on lightly grazed pasture gained 38 pounds.

In the wintering phase the rations were: (1) grazing only, (2) grazing plus 1 pound daily of 20 percent protein supplement, (3) grazing plus 8 pounds of wheatgrass hay daily, (4) grazing plus windrowed hay, and (5) grazing plus 1 pound of 40 percent soybean oil meal daily. Average losses per cow during the winter of 1949-50 were 170.0, 95.4, 146.4, 151.7, and 43.8 pounds for rations in the order listed above. Thus the cows receiving the 40 percent soybean oil meal supplement showed the lightest loss in weight though at the highest wintering cost. (Project 121. Leader: R. O. Smith, Animal Husbandry Department.)

Joint Use of Range by Cattle, Sheep and Antelope

The three primary purposes of this project are: (1) To determine the optimum carrying capacity of ranges in the

northwestern part of South Dakota, (2) to determine the advantages of joint use of range by cattle, sheep, and antelope, and (3) to determine the interrelationship of parasites with the three host species of animals mentioned.

Until the spring of 1950, efforts had been directed at getting the range fenced, developing water for stock, and acquiring equipment and livestock. A carrying capacity survey was made as a basis for laying out the various pastures. In May, 1950, cattle and sheep were placed on the various experimental pastures, but first results will not be available until later. (Project 177. Leader: R. O. Smith, Animal Husbandry Department, Mike House, Supt., Antelope Range.)

Hay and Concentrate Rations for Wintering Bred Ewes

A band of 240 bred range ewes is maintained each winter in 12 groups with different feeding treatments to determine: (1) a desirable level for feeding barley as a concentrate, (2) the value of alfalfa hay as the only roughage in com-

parison with a mixture of alfalfa and wheatgrass hay, and (3) whether chopping either alfalfa or mixed hay is economical. The effect of treatment is measured by ewe gains and lamb and wool production.

Although three winter feeding periods have been concluded, complete wool and lamb production figures for 1950 will not be available until later in the year.

On the basis of the wintering data these conclusions are apparent concerning ewe gains:

1. When long hay is fed, ewes receiving a mixture of 1 pound of alfalfa and 2.5 pounds of wheatgrass hay make greater average gains than ewes fed 3.5 pounds of alfalfa hay. When the hays are chopped the above mentioned differences do not occur, but, on the average, gains are greater than when long hay is fed.

2. When comparing lots of ewes fed hay rations alone, both long and chopped, with lots of ewes fed barley at either of two levels in addition to the hay, it is evident that the supplemental barley feeding produces greater ewe gains.

3. Preliminary data indicate that ewes fed chopped hay produce more wool, and lambs heavier at birth and at weaning than ewes fed long hay. However, these differences are slight.

4. Including barley in the ration results in slightly greater lamb weights and wool production. Feeding more than one-third pound barley per head daily does not appear to be profitable, (Project 159, Leader: J. W. McCarty, Animal Husbandry Department, Harry E. Weakly, Supt., Newell Substation.)

Feeding Ewe Lambs During First Two Winters

Nutritional treatment of ewes during their first two winters is being studied to determine how these treatments affect the early development of the ewes as well as their lifetime performance. Per-

formance is measured in terms of ewe gains and lamb and wool production.

The nutritional treatments are as follows:

1. Low—1 pound alfalfa hay, 2 to 2.5 pounds wheatgrass hay.

2. Medium—1 pound alfalfa hay, 2 pounds wheatgrass hay, one-third pound barley.

3. High—1 pound alfalfa hay, 1.5 to 2 pounds wheatgrass hay, two-thirds pound barley.

Results show that a high plane of nutrition the first winter is more important than a high plane the second winter. Feeding at medium or high levels the first winter followed by any of the three levels the second winter produces the most satisfactory cumulative 2-year performance. Maintaining the lambs on hay alone the first winter, followed by feeding at medium or high levels the second winter does not permit satisfactory development and performance.

Feeding ewes at the low plane both winters results in ewe gains the second winter which are less than the weight of the lamb produced. The lambs average lighter in weight at birth, than lambs from ewes maintained at higher levels. At this level of feeding average fleece weight is not essentially different from that of ewes fed at higher levels.

A second group of ewe lambs has been carried through one winter. Production records will be collected for this group as well as for older groups of ewes which were used in this experiment. (Project 161, Leader: J. W. McCarty, Animal Husbandry Department, Harry E. Weakly, Supt., Newell Substation.)

No Advantage in Feeding Thyro-Protein to Lactating Ewes

While the feeding of thyro-protein has at times caused increases in the amount of milk and butterfat produced by dairy cows, tests with sheep at this Station indicate that there is no advantage in supplementing the rations of lactating ewes with thyro-protein. While

thyro-protein was being fed, there was little difference in the rate of gains made by the lambs nursing ewes receiving thyro-protein as compared to the lambs nursing the control ewes. However, as soon as the thyro-protein feeding was discontinued, the rate of gain made by the lambs in the thyro-protein lot was reduced materially. (Project 205. Leader: R. M. Jordan, Animal Husbandry Department.)

Factors Influencing Feedlot Fattening of Lambs

Six years of work have been completed in which various types of feed, forms of feed (ground and unground), self feeding, frequency of feeding, number of lambs per feedlot, and size of feedlots were compared in various combinations. The trials indicated that corn was superior to barley, and self-fed lambs made more rapid gains than hand-fed lambs. However, frequency of feeding, number of lambs per feedlot, and size of feedlot had little bearing on the average daily rate of gain, feed consumption, efficiency of feed utilization, or death loss of the lambs. The results are published in detail in Bulletin 403, "Feeding Dakota Lambs." (Project 160. Leader: R. M. Jordan, Animal Husbandry Department, Harry E. Weakley, Supt., Newell Substation.)

Urea-Fortified Feeds Result in Gains

Many ranchers and livestock feeders of South Dakota question the advisability of including urea-fortified protein supplements in their cattle and sheep rations. In feeding tests with pregnant ewes on brome grass hay, protein supplements containing soybean oil meal and alfalfa meal plus 5 and 10 percent levels of urea were compared with soybean oil meal supplement. One-half pound of corn per ewe was fed daily for the last 28 days of the gestation period.

The first year's work yielded the following results: (1) Pregnant ewes receiving urea-fortified feeds made as

good, or better, gains as the ewes receiving the simple soybean oil meal supplement, (2) supplements with three parts of alfalfa meal to one of soybean oil meal produced gains greater than those obtained from supplements with equal parts of alfalfa meal and soybean oil meal, and (3) rations caused no significant differences in fleece weights or in weight, condition, vitality, and livability of lambs at birth. (Project 200. Leader: R. M. Jordan, Animal Husbandry Department.)

Breeding of No-Tail Sheep Progresses

A considerable amount of progress has been made in the breeding of No-Tail sheep during the last 37 years at the Experiment Station. From the data gathered during this period of time the following conclusions can be drawn:

The No-Tail sheep are white-faced, have no wool on the face or on the legs and are quite similar to Corriedales in appearance, but the lambs usually are born without tails. Unlike the original stock from which they descended, i.e. from fat-rumped Siberian sheep, no tendency to a fat rump is evident in any of the individuals in the flock. The No-Tails are medium in size and shear about 7 to 10 pounds of three-eighths to quarter-blood wool. Their prolificacy is only fair, ranging from about 110 to 125 lambs born per hundred ewes lambing. Their milking ability is quite extraordinary and excels the breeds generally raised in the cornbelt area.

The No-Tails compare favorably with the Cheviot in their ability to rustle their feed and in their general activity. The lambs are strong and healthy at birth, are born with little difficulty, and nurse in a shorter period after birth than is true of most breeds. Although the No-Tails are fine-boned and have small heads, their feedlot gains are comparable with the general run of feeder lambs. Gains of .3 to .45 of a pound per lamb daily in the feedlot are not uncommon.

The exact mode of inheritance of the

tailless characteristic has not been determined, but it does appear to be recessive. Consequently in a cross between No-Tails and normal long-tailed breeds the lamb would be born with a normal tail. It would not be until further crosses were made to the No-Tails or interbreeding of crossbreds was done that lambs without tails would be produced.

In the fall of 1949 some of the No-Tail ewes were transferred to the Antelope Range Station to be tested under range conditions. Also some No-Tail rams were mated to range ewes at that station for further tests of the usefulness of the breed under range conditions. (Project 9. Leaders: J. W. Wilson and R. M. Jordan, Animal Husbandry Department.)

Sagebrush as a Feed for Sheep and Antelope

Several million acres of western South Dakota ranges have stands of sagebrush varying from light to heavy density. It is believed that sagebrush constitutes an important feed for antelope at all times. During heavy snow in winter or drought in summer, sheep and, to a lesser extent, cattle consume this plant. A preliminary test was made to determine the palatability, digestibility, and feeding value of this plant to sheep and antelope. The South Dakota Department of Game, Fish, and Parks cooperated by supplying the antelope, sagebrush, and prairie hay required for the experiment.

It was found that sagebrush was more palatable to antelope than any of the feeds normally used for livestock feeding. In fact they would not eat other feeds, not even prairie hay. Sheep did not relish sagebrush, but consumed enough during an experimental period of three weeks to maintain their condition.

Chemical analysis of sagebrush cut in December and January showed a crude protein content of 6.18 percent, which compares favorably with fair quality prairie hay. In digestion trials it was found that antelope digested dry matter and crude protein slightly better than

sheep did, but the sheep had higher digestibility of ether extract and carbohydrates. (Project 202. Leader: Paul Kohler, Animal Husbandry Department.)

Lamb Feeding, Cobalt, See page 18

Lamb Feeding, Norghum, See page 40

Lamb Feeding, Stilbestrol, See page 77

Norghum Sorghum and Feebar Barley Compared with Shelled Yellow Corn for Fattening Pigs

In December, 1949, 40 weanling pigs were selected from fall-farrowed litters and divided into four lots of 10 pigs each. The first lot of pigs (Lot I) was fed shelled yellow corn, Lot II was fed ground barley, Lot III was fed ground Norghum sorghum, and Lot IV received whole Norghum sorghum. All four lots received the same protein and mineral supplemental mixtures. The grains, protein supplements, and mineral mixtures were self-fed, free choice in all lots. Grains and protein supplements were fed in outdoor concrete lots and the mineral feeders and self-waterers were indoors. The Feebar barley and Norghum sorghum fed in Lots II and III were ground to a medium degree of fineness. Test weights on the grains were as follows: corn, 53.5 pounds per bushel; barley, 42 pounds per bushel; and sorghum, 54 pounds per bushel.

The data presented in the table on the next page is a summary of this feeding trial.

The greater feed requirement of the barley-fed pigs may be attributed partly to the fact that the barley had a test weight of only 42 pounds per bushel. The pigs fed whole sorghum consumed the greatest amount of protein supplement (49.1 pounds) and the pigs fed the barley consumed the least (37.8 pounds). This low intake of protein supplement is true in most feeding trials where barley is compared with corn.

The rate of gain per pig per day in the sorghum-fed lots exceeded that in the corn- and barley-fed lots. Whole sor-

Items compared	Lot I Shelled yellow corn	Lot II Feebar barley	Lot III Ground Norghum sorghum	Lot IV Whole Norghum sorghum
Number of pigs	10	10	10	10
Average number days on feed per pig	103.0	103.0	99.0	95.5
Average initial weight per pig, lbs.	55.2	53.4	55.8	56.1
Average final weight per pig, lbs.	224.4	224.0	224.9	224.4
Average total gain per pig, lbs.	169.2	170.6	169.1	168.3
Average daily gain per pig, lbs.	1.64	1.51	1.71	1.76
Feed consumed per pig:				
Average daily grain, lbs.	5.81	6.10	6.11	6.25
Average daily protein supplement, lbs.*	.70	.57	.78	.86
Average daily mineral, lbs.†	.06	.04	.06	.05
Average daily feed, lbs.	6.57	6.71	6.95	7.16
Feed consumed per cwt. of gain:				
Shelled corn, lbs.	354.3			
Feebar barley (ground), lbs.		403.9		
Norghum sorghum (ground), lbs.			357.5	
Norghum sorghum (whole), lbs.				354.7
Protein supplement, lbs.	43.0	37.8	45.8	49.1
Mineral mixture, lbs.	3.7	2.9	3.7	2.7
Total lbs.	401.0	444.6	407.0	406.5

*Protein supplement consisted of two parts tankage, one part soybean oil meal, and one part dehydrated alfalfa meal. One pound of vitamin A and D oil (1000A-4000D) was added to each 400 lbs. of the protein supplement.

†Mineral mixture consisted of two parts steamed bone meal, two parts ground limestone, and one part iodized salt.

ghum produced the greatest average daily gain per pig (1.76 pounds). The gains on ground sorghum (1.71 pounds) were nearly equal to those on the whole sorghum. The average daily gains per pig on corn and barley were .12 pounds and .25 pounds less, respectively, than the gains on the whole sorghum.

In this trial, it is apparent that the grinding of Norghum sorghum did not increase its feeding value enough to pay for the cost of the grinding. Throughout the trial a noticeable amount of the whole sorghum kernels were observed in the feces of the pigs fed whole sorghum, but apparently this had little effect on either the rate of gain or the economy of gain.

On the basis of this information, Norghum sorghum compares very favorably with corn for growing and fattening pigs on the basis of feed efficiency and excels corn slightly on daily gains produced per pig. Feebar barley, keeping in mind that this barley weighed 42 pounds per bushel and the standard weight of barley is 48 pounds per bushel, did not produce as rapid gains or as efficient gains as did the corn. (Project 85S. Leaders: R. F.

Wilson and H. Barnett, Animal Husbandry Department.)

Improving Swine Production in Irrigated Areas

This project is designed to improve swine production efficiency through breeding and feeding in irrigated areas. Due to insufficient rotation pasture, only breeding work has been carried on in recent years.

The swine are an inbred line of Hampshires which show signs of excellent production under good management. Crosses in commercial herds have made very good performances.

The results of the 1949 season show an average per sow of 10 pigs farrowed, 4.1 pigs weaned, and 3.4 pigs raised to 154 days of age. The average 56-day weight was 24.6 pounds and the average 154-day weight was 136 pounds. The inbreeding in the sows averaged 20.9 percent compared to 26.2 percent in the litters. Of the pigs farrowed, 77.9 percent were eligible for registration. (Project 132. Leader: Richard O. Smith, Animal Husbandry Department, Harry E. Weakly, Supt., Newell Substation.)

Comparing Spring, Summer, or Fall Farrowed Pigs for Greatest Profit

The purpose of this project is to compare the efficiency of raising pigs which have been farrowed in spring, summer, or fall. Twelve gilts (their second litters were produced the following fall) and twelve sows (their first litters had been produced the previous fall) were bred to farrow in late February and early March. Another twelve gilts were bred to farrow in April, another twelve gilts were bred to farrow in June, and twelve gilts were bred to farrow in the fall (their second litters were produced the following spring). Not all of the gilts and sows which were bred actually farrowed. Durocs are being used in this experiment.

Presented in the table below are the data for the years 1948 and 1949.

It will be noted that in 1948 the greatest return per pig came from those pigs farrowed in June (Lot 3) under one-litter system, followed by those pigs farrowed in April (Lot 2). The lowest net return per pig was received from the lot farrowed in March (Lot 1). The great difference in net returns per pig between Lots 1 and 3 can in part be accounted for in the number farrowed per female in each lot and in the survival rate of the pigs in each lot from farrowing to wean-

ing. An average of 1.3 pigs more per female was farrowed in Lot 3 than in Lot 1; and the survival rate from farrowing to weaning in Lot 3 was 79.4 percent as compared to 53.6 percent in Lot 1.

In 1949 the returns per lot, with the exception of Lot 1 ('49), dropped considerably from what they were in 1948. The greatest net returns were obtained in Lot 1 ('49). The pigs in this lot were farrowed by sows which had farrowed their first litters in August, 1948 (Lot 5).

Feed costs per lot in 1949 were somewhat lower than those in 1948. This was caused partly by lower feed prices, but also in part by the proportion of weaned pigs and pigs reaching market weight. The average price received per hundredweight per lot was considerably less for some lots in 1949 than it was in 1948. The market pigs from the 1949 lots were sold on a gradually declining market, \$18.13 per hundredweight for Lot 1 ('49) to \$15.23 per hundredweight for Lot 4 ('49).

Other costs such as labor, straw, housing, pasture, etc., were relatively the same for 1948 as for 1949.

Under the two-litter systems, Lots 1 and 4, and Lots 5 and 1 ('49), there appears to be a slight advantage in favor of the system where gilts farrowed their first litters in the spring and their second

Income, Cost, and Net Returns per Pig and per Hundredweight Pork

Lot number One-litter systems	Month and year farrowed	Farrowed by	Total income per pig	Total cost per pig	Total net return per pig	Total income per cwt.	Total cost per cwt.	Total net return per cwt.
1	Mar. '48	Gilts	\$58.87	\$47.31	\$11.56	\$26.33	\$21.15	\$5.18
2	Apr. '48	Gilts	55.42	37.27	18.15	24.51	16.50	8.01
3	June '48	Gilts	48.92	29.70	19.22	21.84	13.25	8.59
4	Sept. '48	Sows	48.46	31.06	17.40	21.97	14.09	7.88
5	Aug. '48	Gilts	49.76	34.66	15.10	22.54	15.69	6.85
1('49)	Mar. '49	Sows	41.54	27.73	13.81	18.62	12.45	6.17
2('49)	Mar. '49	Gilts	39.91	39.36	0.55	17.87	17.62	0.25
3('49)	Apr. '49	Gilts	35.10	27.56	7.54	15.68	12.75	2.93
4('49)	June '49	Gilts	34.59	29.49	5.10	15.42	13.14	2.28
Two-litter systems								
1 & 4	Spring and Fall '48	Gilts and Sows	52.72	36.43	16.29	23.78	16.43	7.35
5 & 1 ('49)	Fall '48 Spr. '49	Gilts and Sows	45.55	29.99	15.56	20.52	13.52	7.00

litters in the fall. The poor survival rate of Lot 1 in the spring of 1949 has had considerable influence on the over-all net returns per pig for this two-litter system.

It appears from these preliminary data that the principal factors which influenced the net returns received per pig or per hundredweight were: the cost of feed, the number of pigs marketed of those farrowed, and the income from the

sows. This study is being continued for several more years. (Project 168. Leaders: R. F. Wilson and T. Wright, Animal Husbandry Department.)

Breeding Swine, See page 5

Harvesting Prairie Hay, See page 88

Heel Fly and Cattle Grub Control, See page 43

Meat, Deep Freeze or Locker Plant, See page 29

Dairy Production

Influence of Winter Housing Conditions on Growth Rates and Feed Consumption of Dairy Heifers

This experiment was continued for the third winter season. Sixteen heifers were selected for this trial which began on November 1, 1949, and ended on April 1, 1950. They were divided into two groups so that the average ages and weights were as nearly alike as possible. One group was kept in an insulated barn which had an average temperature of 41° F. for the period; the other group was kept in an uninsulated barn having an average temperature of 27° F.

Results of this trial were similar to those secured during the two previous seasons. Growth rates as measured by weight, chest circumference and height at withers were more rapid for the heifers housed in the warmer barn than for those in the colder barn. The average differences in gains per animal for the period were 61 pounds in weight, 4.4 inches in chest circumference and 1.8 inches in height at withers. Records of feed consumption show that the heifers in the warmer barn ate 12.0 pounds of hay daily as compared to 17.2 pounds for those in the cold barn. Each animal in both groups was fed 20 pounds of silage daily. No grain was fed during the trial. (Project 153. Leader: Emery Bartle, Dairy Husbandry Department.)

Milking Machine Sanitation

Investigations of methods of sanitizing milking machines were continued. A rinse technique was developed to determine the number of bacteria which remained in the machine after these treatments, and it was possible to estimate the relative amounts of bacterial contamination in different parts of the combine milker using this procedure. The surface cooler and the alternator-releaser jars, which permitted the milk to flow over the cooler, were found to be the sources of greatest contamination.

During the past several years it has been common practice to take the milking machine apart each day and wash each part with a brush in a suitable cleaning solution. A flush washing method was developed which made it possible to eliminate the daily brushing of each part. Preliminary tests indicated that it was unnecessary to take the machine apart more frequently than once a week. This system has been used during the past ten months with satisfactory results, its chief advantage being that it saves labor. It is probable that further research on methods of flush sanitization will give additional improvement and that brush washing will become less frequent. (Project 155. Leaders: D. F. Breazeale and G. E. Turner, Dairy Husbandry Department.)

Manufacturing Cottage Cheese

When this project was started a critical milk shortage existed in many South Dakota communities during the season from August to December. Due to this shortage, products, such as cottage cheese, were not manufactured in sufficient quantity to meet the demand for them. When they were available only at irregular intervals, the demand soon decreased and potential sales were lost. If cottage cheese of acceptable quality could be manufactured from dry milk solids not fat, these markets might be maintained during the season of low production. This project was designed with the purpose of developing manufacturing methods by which high quality cottage cheese could be made out of milk reconstituted from dry milk solids not fat and water.

Pasteurized skim milk was used for many batches of cottage cheese in an effort to develop control methods which could be applied to the manufacture of the cheese from reconstituted skim milk. Some of the factors studied were (1) rate of rennet coagulation of the milk, (2) strength of the curd, (3) effects of added salts, such as calcium chloride and sodium citrate, (4) influence of the amount of acidity at the time of cutting and time of cooking, (5) relationship of titratable acidity and pH, and (6) variations in manufacturing procedure to determine optimum conditions.

The results to date indicate that: (1) The control of acidity during the cooking process is very important. This seems to be more critical when reconstituted skim milk is used than when fresh pasturized skim milk is used. (2) A proper balance of salts is necessary for good cheese. (3) Cottage cheese of acceptable quality can be manufactured from reconstituted skim milk with comparatively little modification in manufacturing methods. (Project 169. Leader: D. F. Breazeale, Dairy Husbandry Department.)

A New Possibility for Proving Dairy Cows

There is an increasing need for more rapid methods of proving the transmitting ability of our dairy sires and dairy cows. Artificial insemination facilitates the proving of a sire under many environmental conditions. At the present time, however, there is no such means for disseminating the germ plasm of the dam.

The possibility of increasing the number of offspring per year per individual has been adequately demonstrated with laboratory animals. If a technique for recovering fertilized ova and transplanting them into a host cow could be perfected and a means of increasing the number of ova liberated per year stepped up, it seems that this should hasten the proving of good dairy cows.

A technique is being investigated for flushing the uterus to obtain fertilized ova. To date a number of fertilized ova have been recovered; however, as yet, these techniques are in the experimental stage and are not ready for release as a means of improving dairy herds.

Fertilized ova recovered from one cow have been transferred to a host cow. None of these implantations has resulted in a full term pregnancy; however, fetuses have been detected as late as the third month of pregnancy. Why these pregnancies have terminated in this early stage will require further investigation. (Project 189. Leader: A. E. Dracy, Dairy Husbandry Department.)

Improvement of Dairy Cattle Through Breeding

This project was suspended during the greater part of the past year. Personnel has been hired for next year to collect data on the progeny of the sires selected by three methods. (Project 184. Leader: P. L. Kelly (resigned Sept. 1949) Dairy Husbandry Department.)

Feeding, Dairy Calves, See page 12

Poultry Production

Relative Values of Common Crop Varieties for Poultry Rations

During the past year the work on this project has been divided into three phases, which are as follows:

1. The effect of feeding large quantities of oats to growing turkeys.
2. The effect of all-mash vs. mash and grain mixtures fed to laying hens.
3. The effect of eliminating animal proteins from the chick starter diet.

Briefly, the results show that:

Oats, when relatively cheap, can be fed to growing turkeys up to 67.5 per cent of the total diet without reducing the final weight of the birds at 28 weeks of age. An all-mash diet was used, in contrast to mash-grain mixtures of previous years, but the results were essentially the same.

For New Hampshire pullets, a 15 percent protein all-mash ration is no better than either a 26 percent protein mash

plus corn and oats, or a 20 percent protein mash plus corn and oats fed free choice. The average percent production did not differ more than 2-percent for a 9-month period. Utilizing as much whole grain as possible is therefore of great advantage in reducing the cost of egg production by saving grinding fees, as long as the birds have access to a mash containing the required supplementary protein, minerals, and vitamins.

Entirely eliminating animal proteins from the chick starter diet is not to be recommended. Even though all-vegetable diets are supplemented with commercial Animal Protein Factor supplement, growth is not as rapid as when animal proteins are also included in the diet. In addition, it was again shown that when hens from which the chicks were obtained were on a diet devoid of animal protein, the chick's requirement for Animal Protein Factor is greatly increased. (Project 52. Leaders: C. W. Carlson, Wm. Kohlmeyer, Poultry Department; A. L. Moxon, Station Chemistry Dept.)

Effects of Inbreeding upon Economic Qualities of Chickens

Inbreeding work was continued on a fast-feathering strain of White Plymouth Rocks. Chick livability and hatchability declined from the levels of previous years. Fertility which has been poor remained about the same. Eggs from experimental top-crosses of inbred White Rock males on White Leghorn and Rhode Island Red tester females were shipped to the Regional Laboratory for testing purposes. Reciprocal crosses were made between outbred New Hampshire males and inbred White Rock females. These will be compared with New Hampshires and White Rocks from the station flock.

An inbred strain of Rhode Island Reds in its second year of development performed satisfactorily, although egg



Inbred male from a fast-feathering strain of White Plymouth Rocks in project on inbreeding.

size was somewhat small. (Project 179. Leaders: D. G. Jones, Wm. Kohlmeier, Poultry Department, Albert Dittman, Supt., Eureka Substation.)

Value of Grain and Forage Sorghums and Proso Millet for Turkeys

A comparison was planned between two lots of turkeys, one of which had access to growing mash and standing sorghum, and the other to growing mash and a combination of standing sorghum and sunflowers.

Wild blackbirds had completely harvested the sunflower seed before it was sufficiently mature for use by the turkeys. Consequently no effective comparison could be made. Losses due to wild birds would seem to limit the value of sunflowers for such purposes. (Project 79. Leaders: Wm. Kohlmeier, D. G. Jones, Poultry Department, Albert Dittman, Supt., Eureka Substation.)

Influence of Feeding and Management Upon Hatchability of Turkey Eggs

During the past several years, research has been conducted to determine what, if any, difference there might be in the effects various sources of riboflavin, natural and synthetic, have on hatchability of turkey eggs. Results have shown that riboflavin from any source is effective in promoting normal hatchability. In the work this year synthetic riboflavin was compared with that from milk products, and in addition a commercial Animal Protein Factor (A.P.F.) supplement was tested for its effect on hatchability.

Eggs were set each week for 16 weeks and the results show that hatchability was not influenced by the source of riboflavin, and also that the presence of an A.P.F. supplement in the diet did not alter the hatchability to any great extent.

Poulters from three hatches were kept and early growth data obtained. The first hatch was fed a diet, the protein of which was from soybean meal and cereal grains; two later hatches were fed a



Weighing chicks to determine rate of growth in animal protein studies. Chicks need animal protein in starter diet.

diet containing animal protein sources. The results indicate that there may be some advantage in promoting rapid early growth of poults through the use of A.P.F. supplements in the turkey breeder diet, especially when the poults themselves are receiving a good diet. The results also show that an all-vegetable diet is not adequate for turkey poults. (Project 96. Leaders: C. W. Carlson, Wm. Kohlmeier, and D. G. Jones, Poultry Department, and A. L. Moxon, Station Chemistry Department.)

Control of Selenium Poisoning in Poultry

The effects on hatchability of turkey eggs obtained when turkey breeder hens receive a diet containing selenized grains have been demonstrated several times. These evidences of selenium poisoning have been a reduction of hatchability of the eggs to zero with the production of embryonic abnormalities, and when less poisonous levels of selenium were fed, the production of a wiry down and poults which do not live. In previous years it has been demonstrated on breeding chickens that small amounts of ar-

senic in the drinking water will overcome the poisonous effects of selenized grains used in making up the diet.

No information is available as to the effect of feeding arsenic to turkeys affected with selenium poisoning. Turkey breeder hens were fed an all-mash diet, a portion of which was selenized grains included so that the diet contained 15 parts per million (ppm) of selenium. After two weeks on this diet, arsenic (as sodium arsenite) was added to the ration at a level of 15 ppm for a 2-week period, following which the selenized grains were replaced by normal grains and arsenic was left in the diet.

The usual symptoms of selenium poi-

soning were obtained, but the addition of arsenic to the breeder diet did not correct the condition. Not until selenium was removed from the diet, did hatchability return to normal. Arsenic fed in this manner did not appear to have any effect in the control of selenium poisoning in turkeys. (Project 28. Leaders: C. W. Carlson, Wm. Kohlmeyer, Poultry Department; A. L. Moxon, Station Chemistry Department.)

Dubbed Hens, See page 52

Egg Marketing Losses, See page 85

Newcastle Disease, See page 66

Fowl Cholera, See page 54

Livestock Diseases, Parasites and Poisoning

Sporadic Bovine Encephalitis Diagnosed

Sporadic bovine encephalitis was diagnosed on five additional farms in South Dakota during the past year. This now makes a total of nine farms where this disease is known to have occurred since it was first recognized in this state in 1946. Inasmuch as the symptoms may be confusing, it is probable that additional cases have occurred but were not recognized as resulting from a new disease. Both young and mature animals have been affected, but the greater number of cases have been among cattle less than one year old. There has been no recurrence of the disease at a later date on any farm, nor has there been any spread to neighboring farms during an outbreak.

In the outbreaks so far studied, the disease has occurred in the months from October to May. To date, no clue can be given as to the manner by which animals become infected.

In the laboratory, the virus of sporadic bovine encephalitis has been recovered from three of the outbreaks and the strains are maintained by growing in

chick embryos. Penicillin, streptomycin and aureomycin have been investigated and only aureomycin shows promise of being effective against the virus by preventing infection of chick embryos. One yearling heifer was treated with aureomycin and showed general improvement within three days. (Project 171. Leader: G. S. Harshfield, Veterinary Department.)

Sheep Parasite Control

For the second year, monthly counts of intestinal parasite eggs in fecal samples were made of the sheep and cattle maintained at the Antelope Range in Harding County. This procedure is being used to follow the course of worm infestations during the year.

The sheep had abundant range and were not herded. As had been noted in earlier studies a heavier infestation of worm parasites in the ewes occurred in early spring (May). This was followed by a marked drop and a continued low level during the remainder of the summer. The lambs of the flock also went through the summer without develop-



A cable-type back rubber used in connection with an experiment at Reed's Ranch. This back rubber is constructed with burlap-wrapped strands of barbwire cable and moistened with DDT solution.

ing any significant infestation. The infestations in the cattle on the same range have been consistently at a very low level.

Beginning with the grazing season this year, the sheep and cattle have been allotted to four fenced grazing areas on the range. This will provide for comparisons of the worm levels in sheep under overgrazing, undergrazing, normal grazing and rotational grazing conditions of management and also in sheep which are using the same range as cattle. (Project 139. Leaders: G. S. Harshfield, Veterinary Department; R. O. Smith, Animal Husbandry Department, Mike House, Supt., Antelope Range.)

Insects, Mites, and Ticks Affecting Cattle, Sheep and Swine

Attention has continued to be directed toward solution of the problem of abnormal loss of toxicity of DDT on livestock during midsummer. Improvement of techniques for obtaining chemical

analyses of residues on hair samples has been accomplished, but a final, workable method has not yet been established.

Work has been started on an evaluation of cable-type back rubbers as a technique for horn fly control on range cattle. Back-rubber units have been set up for observation at Reed's Ranch in Lyman County. Observations are being made on various private herds that are being exposed to this promising method of treatment. Hair and fat from treated and untreated animals have been subjected to chemical analysis for DDT residues. Five different analytical methods have been explored and an apparently reliable method has been adopted. Preliminary data indicate that DDT is deposited, but in small amounts, in subdermal shoulder and back fat of cows exposed to back rubbers for an entire season. Patch tests for dermal toxicity of DDT solutions used on back rubbers have been performed. Application of DDT in mineral oil solution, at a rate

exceeding the amount normally obtainable from a back rubber cable, has produced skin lesions, but no similar lesions have yet been seen under field conditions.

Fly control in barns has been investigated, using insecticides such as lindane, dieldrin and DDT. Fly populations before and after spraying were evaluated by means of the modified Scudder grille. Especially good control of house flies and stable flies was obtained with dieldrin.

Several thousand sheep infested with keds (sheep ticks) have been sprayed with toxaphene, sprayed and dipped in lindane. Final data are not yet available.

A cooperative investigation of chemical control of swine mange has been pursued with Dr. I. H. Roberts of the Zoological Division of the Bureau of Animal Industry, U.S.D.A. Tests of low concentrations of lindane and chlordane have been evaluated. Pre-spraying scrapings, and repeated post sprayings have been made for each experiment conducted. (Project 186. Leader: Wm. M. Rogoff, Entomology Department.)

Methods of Alleviating Selenium Poisoning in Farm Animals Studied

During the past year, considerable effort has been made to complete some, and correlate all, of the various phases of the selenium toxicity study. Most of the data of the past three years have been published and will be available to those who are interested in technical reports. The following summary covers the experimental work of the past year.

The use of arsenic, when fed with salt to farm animals, still remains the only practical way to alleviate the effects of selenium poisoning in farm animals. At the Reed ranch, two lots of 5-year-old cows and two lots of 2-year-old heifers have been used to determine what effect the continued use of arsenic might have on animal reproduction. One lot of cows and one lot of heifers have had salt containing 37.5 parts per million of arsenic

continuously. The other two lots have had plain salt. To date, there has been no apparent detrimental effect of the arsenic on reproduction or other animal physiologic processes.

In the laboratory, two more experiments designed to determine the effect of dietary methionine supplementation on selenium toxicity in the rat were completed during the year. The experiments, four in all, have shown that this amino acid is ineffective in the protection against selenium toxicity in the rat.

Another point of attack on the mechanism of selenium poisoning has been started by trying to identify the chemical compounds excreted by selenized animals. It has been found that approximately 30 percent of the selenium of an injected sub-lethal dose of selenite was excreted by the lungs of the rat within 24 hours. Isolation and characterization of the selenium product(s) as well as the effect of arsenic on this process are to be investigated. It is hoped that some knowledge of selenium reactions within the animal body might be gained from this work.

Recent publicity concerning the Animal Protein Factor (APF) has been of much interest to the farmer. This material was included as a supplement to various protein feeds to see what effect, it would have on animals receiving a toxic diet. Although the APF did help to increase the growth rates of the rats, it did not prevent the liver damage caused by the selenium.

Another interesting phase of this work is the protective effect that is noted when linseed meal is fed to animals that are eating selenized grain. It appears that the protective factor(s) of the meal is in the berry of the flax seed, and further separation in an attempt at isolation of this factor is now underway.

Further work with enzymes still places the succinoxidase system as the most selenium-sensitive enzyme studied to date. In an effort to explore enzymic systems other than those involved in

carbohydrate breakdown, experiments are now in progress with enzymes involved in protein metabolism. It is felt that the enzyme experiments have furnished the most promising guides in the problem of selenium toxicity and further work will emphasize this part of the research. (Project 19. A. L. Moxon, H. L. Klug and D. F. Petersen, Chemistry Department; R. Smith, Animal Husbandry Department, cooperating on work with cattle at the Reed Ranch in Lyman County.)

Corn Plants Analyzed to Discover Causes of Cornstalk Poisoning

To evaluate the changes in the composition of corn plants which are associated with cornstalk poisoning of cattle, it is necessary to obtain considerable basic information on the chemical composition of corn plants and also of certain changes in these chemical constituents which occur in response to particular treatments.

The changes occurring in the water-soluble amino acids of young corn plants fed ammonium nitrogen in excess as compared with corn plants starved for nitrogen have been explored. This treatment, in experiments conducted at this Station, has been previously reported to result in about a five-fold increase in water-soluble amino acid content of the fertilized set of corn plants. It has been

determined during the past year, using the starch column technique of Stein and Moore, that not all of the amino acids increase in proportionate amounts. The main increase in amino acids of the roots of corn plants is attributable to alanine, glutamic acid, aspartic acid, arginine, and so-called "underglutamic" acid; in the green tops of the corn plant arginine, alanine, glutamic acid, and valine increase at rates above or equal to the overall increase in amino acid content.

A plot of flint corn was planted at the Central substation, Highmore, last year and cattle were turned into the plot in the fall.

No symptoms of cornstalk disease were observed in the cattle. Highmore is located in a general area in which cattle losses from cornstalk disease occur almost every year. Last year, however, no losses were reported from that general area. A plot was planted in flint corn again this year. Samples of the corn will be taken for analysis and cattle will be turned into the plot this fall for observation. (Project 130. Leaders: E. I. Whitehead, A. L. Moxon and Frances L. Moyer, Station Chemistry; G. S. Harshfield, Veterinary; C. M. Nagel, Plant Pathology.)

Newcastle Disease, See page 66

Fowl Cholera, See page 54

Farm Engineering

Farm Building Materials Evaluated

A farm building material and design project was set in motion during the past year. Information on service and design for future plans has been secured on a number of buildings on the South Dakota State College farms and on a few other individually owned farms. Items under study on which information was secured include farm building roof coverings, foundations, long span rafters, and wall coverings. Existing records and buildings are being investigated, recorded, and evaluated.

During the past fiscal year a survey has been made of farm building materials on 30 farms in eastern South Dakota in cooperation with the North Central Regional Project NC-4, "Selection and Utilization of Materials for Farm Buildings." The survey collected field data on various phases of the project which were also included in the regional study.

Two specific findings on materials to date are: (1) A large percentage of galvanized metal and aluminum roofing in use today has been improperly nailed. (2) Approximately 50 percent of asphalt roofing encountered in the survey showed improper application. (Project 203. Leader: Dennis L. Moe, Agricultural Engineering Department.)

New Harvest and Threshing Machinery for South Dakota

Harvesting and threshing of a variety of bean crops was made necessary by the need of planting beans as a war-time emergency crop. Low-growing varieties, such as navy beans, pinto, teppary, great northern, etc. required vine cutting and windrowing before the vines would dry properly. Vine-cutting machinery was not available during war time, and therefore a cutter was made in the experiment station shops. A combine with pick-up was used to thresh the windrowed beans.

Combines proved to handle all bean crops satisfactorily. Cylinder speeds need to be greatly reduced to prevent cracking of the large seed. Weed growth in the rows of low-growing bean plants proved to be more of a problem than the threshing procedures.

Soybeans can be direct combined late in the fall, after frost, and prove to be much more suited to the existing machinery and farming practices of South Dakota farmers. Only the very early, low-growing varieties showed a noticeable shattering loss at the cutter bar after special canvas reel flaps were installed.

A field baler, with its complement of wagons and tractors, was observed in the 1945 harvest season. A special wagon hitch was made to trail wagons back of the baler so that bales could be loaded and hauled to the barn immediately. Man power required to keep such a machine group operating was as follows: Three men in the field with baler and loading, two men hauling, and two or three at the barn unloading and piling. Labor costs were fixed at \$35 to \$45 per day in 1945. Fuel costs were \$9 per day for all tractors and baler motor. When other items of machine depreciation and interest are added, total daily costs amount to \$66 per day, \$1.40 per ton, or about \$0.088 per bale. There is a great variation in bale size and density, however, depending on machine adjustments. The above costs are for bales delivered to the barn. Custom operators who bale only, and drop the bales in the field have less than one-half of the labor cost, a little more than one-half the machinery cost, and about one-half the total daily cost. Operation speeds can be faster, as fewer stops are required.

A field ensilage cutter and complement of hauling and elevating machines were observed during the 1947 silo filling season. Average field travel with a heavy duty field ensilage cutter was $1\frac{1}{4}$

mph; a wagon loaded with corn silage averaged one in 14 minutes. (When the field is located long distances from the silo, it is an advantage to use trucks for higher road speeds.) Unloading time at the silo where tractor and blower were used averaged 7 minutes, thus giving more than adequate time for changing wagons and cleaning around the blower. Two men, at least, were needed during the unloading process, even though dump-trucks, or wagons with unloading mechanisms were used. There is real need for a wagon equipped with a uniform unloading device which will reduce the number of men needed to do the unloading. The field ensilage cutter has eliminated the very laborious procedure of handling bundles from the corn binder. (Project 136. Leader: H. H. DeLong, Agricultural Engineering Department.)

Test Galvanized and Painted Steel Fence Posts

The purpose of this fence post study was to determine from the standpoint of appearance and length of life of the post, if it would be better to purchase galvanized steel fence posts rather than common painted steel posts.

One thousand Banner, 6½-foot, drab gray steel posts of the studded "T" type were set out at various places on the South Dakota State College farms. All the posts were set 2 feet in the soil, 15 feet apart. Five hundred of the steel posts were galvanized at the factory. The additional 500 were not galvanized but were dipped in a common paint. A heavy woven wire fence, 48 inches high, was used on all the posts.

In 1932, seven years after the posts were set, approximately one-half of the paint was missing on the painted posts and considerable rusting was taking place. Therefore, 400 of these posts were repainted in lots of 100 with four different types of paint, namely: metallic zinc, lead-oil (hand mixed), lead-oil (com-

mercial), and titanium lead-oil (commercial). All of the paints were applied by hand brushing.

On a few galvanized posts, small pin head size blisters could be noticed after a period of 12 years. After 25 years many small blisters were found on all the galvanized posts. However, just a very small number of the blisters were broken showing a small rust spot within. This small blister rusting did not in any way decrease the value of the post itself. Some discoloration, but no rusting, of the posts was present where an ungalvanized woven wire fence was used. Some very decisive conclusions were drawn from the fence post study:

1. Common paint on new steel posts may be expected to fade in three years, definitely fail in five years, and be black with rust after 12 years.

2. Repainted steel posts with lead-oil paints may be expected to be badly faded, dull, and blotchy in appearance after 10 years.

3. Applying lead-oil paints by brush is far superior to dipping the posts in paint.

4. The four paints used could be rated in the following order for durability and appearance:

Metallic zinc

Commercial lead-oil

Hand mixed lead-oil

Commercial titanium lead-oil

5. Metallic zinc paint was the best paint by a wide margin, being in good condition after 18 years.

6. Galvanized posts may be expected to be very good in both appearance and serviceability after 25 years.

7. In the North Central States, metallic zinc painted posts will give as good service as galvanized posts, and in addition may be purchased at a lower first cost. (Project 15. Project Leader: Dennis L. Moe, Agricultural Engineering Department.)

Farm Electrification, See page 80

Septic Tanks, See page 7

Sprinkler Irrigation, See page 98

Methods of Water Application on South Dakota Lands Tested

In the development of practical methods of water application on South Dakota soils, the following accomplishments were completed the first year:

1. Nine small Parshall flumes were constructed and used for measuring permeabilities on the "in place" soil samples.

2. Four irrigations were accomplished on 24 plots (12.4 acres) throughout the growing season for the barley and Hubam clover. All irrigation water was measured with Parshall flumes, and the over-all runoff was measured with a Parshall flume equipped with a Friez recorder. Time rates of movement of irrigation waters were observed and soil moisture measurements were made before and after each irrigation. Moisture samples were taken throughout the

upper 4 feet, and moisture measurements were accomplished in the laboratory on these samples.

3. Water measurements were made on 40 rows. The water was measured on and off volumetrically while small Parshall flumes and 90-degree notch weirs were checked against volumetric measurements.

4. Apparent specific gravity measurements were made on 41 "in place" soil samples, taken with the Pomona soil sampling device. These samples were taken throughout the upper 4 feet at various locations on 24 plots.

5. Thirty-five "in place" samples were taken with the Pomona soil sampler throughout the upper 4 feet on 12.4 acres. Samples were taken to the laboratory and permeability measurements were made. (Project Cooperative Leader: Leonard J. Erie, Agricultural Engineering Department.)

Farm Economics and Community Welfare

Improving the Crop-Share Lease

Insecure tenure, due largely to the one year, or year-to-year lease, is a serious obstacle to good farm management and desirable family living. This is especially true in those areas where a shift from cash grain to grass and livestock farming is needed. Tenants are reluctant to seed legumes and grasses and make improvements on buildings and fences when they may have to leave next year. As a result, both the landlord and tenant suffer.

Landlords appear to be reluctant to make long-term leases, perhaps because they are afraid that the tenant will farm in such a way as to reduce the landlord's crop-share rent. If this is true (it needs further testing), then a lease which has the advantages of a crop-share lease but removes the "partnership" aspects of it needs to be devised.

Such a lease has been prepared, but needs further work before it is made

available for general distribution. Work on this lease will be continued during the next year and data from a field survey will be analyzed. (Project 147. Project Leader: Russell L. Berry, Agricultural Economics Department.)

Land Price Movements Studied

Land price movements constitute one of the important factors in South Dakota agriculture. A thorough study is being made of all land transactions in seven selected counties for the period 1941-1950 inclusive. From this information will come facts useful to buyers and sellers of farms over the state. A 10-year summary bulletin is planned.

A general summary of recent economic trends has been published entitled, "Graphic Views of Changes in South Dakota Agriculture." (Project 157. Leader: Gabriel Lundy, Agricultural Economics Department.)

Changes in Methods of Farming Studied for Irrigation Areas

Farmers living in areas proposed for irrigation can eliminate the drought hazard that has plagued them since this state was first settled. But to pay for irrigation water may require drastic changes in methods of farming. What crops and livestock will be best suited to pay the costs of dam construction, ditching, and water charges? Will weeds and insects pose new problems? What is the best method of making the payments? What share of the benefits of dam construction and irrigation do farmers receive? How should costs of irrigation development be divided among those who benefit? How can the land be most economically developed and settled? What credit and tenure arrangements will need to be made? These are a few of the questions that are being asked in a study just started this year.

It is hoped that these questions can be answered in time to be of material benefit to farmers in the areas proposed for irrigation. (Project 198. Leader: Russell L. Berry, Agricultural Economics Department.)

Market Potentials of Crops Produced in Irrigated Areas Appraised

Because of its size, prospective production from the Missouri Basin development might well disrupt the market for established production areas unless it is planned in the light of its competitive and complementary relationships with other areas. For example, if the same percentage of sugar beets were grown under proposed irrigation as is generally utilized in existing irrigated areas of the Great Plains states, the acreage of sugar beets produced in the continental United States would be increased by more than 50 percent. Obviously, the prospective effects of such an increase in production should be appraised. The demand for row crops in crop rotations in order to control weeds will give crops such as

sugar beets, potatoes, beans and corn a definite place in crop rotations of areas suitable to their production, but a careful appraisal of market prospects and market facilities will be essential to sound development.

In this project data has been assembled concerning production and consumption of the various crops which can be produced under irrigation. A survey of present marketing and processing facilities has also been undertaken in order to obtain data for use in determining the need for added facilities under irrigation. (Project 197. Project Leaders: O. Nervik and E. Feder, Agricultural Economics Department.)

Marketing Slaughter Lambs by Carcass Grade and Weight

Producers and others have gradually realized that the class and grade terms used to describe a particular slaughter animal should be directly related to its carcass. A choice lamb should produce a choice carcass, and a good lamb a good carcass. Official United States standards for slaughter livestock and carcasses are defined in subjective or descriptive terms rather than on the basis of objective tests or measurements.

This study is concerned both with the desirability and practicability of marketing slaughter lambs by carcass grade and weight. More attention is given in the study to problems relating to the practicability of the method. (Project 156. Project Leaders: O. Nervik, Agricultural Economics Department, and Ellis A. Pierce, Animal Husbandry Department.)

Methods of Marketing Feeder Cattle in South Dakota

The production and marketing of feeder cattle and lambs is one of the more important agricultural enterprises in South Dakota. According to information obtained in this study 53 percent of the farmers and ranchers consider either

the production of feeder cattle, or the feeding of such livestock, to be their major livestock enterprise.

The purpose of the study is to obtain basic information about the methods in which feeder livestock is marketed in the state. It was found that transportation is one of the more important problems facing South Dakota ranchers and farmers. A number of case studies of livestock shipments show that losses through shrinkage in transit are very high, causing considerable loss to shippers. (Project 176. Project Leader: O. Nervik, Agricultural Economics Department.)

Maintaining and Expanding the Market for Dairy Products

This research concerns itself at present with the efficiency of the price formation process and with the relationship between prices, price formation, and market outlets for butter. The methods by which the prices for butter are established at local creameries, their adequacy and possible improvements are being evaluated.

An important aspect of the price analysis concerns the grades of butter to which the prices apply. Data have been obtained from creameries on grades and quality of butter shipped in bulk.

Information on local creameries has been obtained on their marketing and pricing practices, such as the relationship between local butter sales and out-shipments, their pricing procedures, their arrangements with buyers, their processing equipment. Results of this research may reveal possible ways and means for South Dakota processors to improve their competitive position. (Project 201. Leader: E. Feder, Agricultural Economics Department.)

Egg Marketing Losses, See page 85

Farm Income, See page 71

Wheat, Overproduction, See page 21

Transferring the Farm, See page 95

Reorganizing School Districts on a Community Basis

The major problem of public school education in South Dakota today is how to merge our separate town and country administrative units into natural community school districts. In effect this would eventually combine rural school districts in the surrounding trade and service areas with that of independent districts, located in the town center.

It should be noted that the school district is an administrative unit, but may contain a number of rural schools or town grade schools with at least one high school for the entire community.

The main purpose of re-organizing school districts on a community basis is to:

1. provide a more adequate tax base
2. improve the quality of education for all pupils in the community
3. produce greater solidarity in community life for both town and country people
4. increase the size of the school district and schools so as to have larger enrollments thus reducing cost per pupil
5. provide transportation for country children to the community center.

Under the present school law the legal term for combining town and country in one district is called, "An Independent-consolidated School District." In the bulletin, we have preferred to change the name of the school district from "Independent-Consolidated" to a "Community District" as it implies a much greater solidarity between town and country.

A joint committee of the Department of Rural Education, National Education Association, and a similar committee from the American Rural Sociological Society, have suggested the 14 points below describing what the characteristics should be of a successful consolidated school district. The 14 points have been modified briefly to adapt them to South Dakota conditions. Adaptations are indicated within the parentheses.

Criteria for a Successful Community School District

In South Dakota, the term, consolidated schools, is used interchangeably with independent-consolidated schools.

1. Such a school district should coincide quite closely with the composite trade and service area of a village, town, or city in which a 4-year high school is located. (The minimum sized community town center should have at least 400 population and good prospects for growth.)

2. The reorganized school district should have a reasonably complete elementary and high school curriculum, including special provisions for adult education.

3. Each school should have a program of well-balanced, extra-curricular activities.

4. It should also have at least 25-30 pupils per grade, and preferably a minimum enrollment of 100 pupils in high school.

5. The school should be the center of many community activities.

6. The teachers should be well-trained and experienced.

7. School attendance should be consistently high at all age levels.

8. The transportation of pupils from outside the town should be both adequate and economical.

9. A consolidated school district may have more than one elementary attendance center, but at least one high school. (It may be desirable, especially in the more sparsely settled areas of the state, to retain certain elementary rural schools until roads are much improved.)

10. The school plant should be adequate and reasonably modern. It may also be desirable to accumulate a reserve building fund for future construction until building costs are stabilized.

11. The school plant should not be too dependent upon funds from outside the country where the school is located.

12. There should be good town-country cooperation. Both town and country groups should be represented on the school board.

13. The school should also have a well balanced pupil-teacher ratio.

14. The school district should have an adequate tax base for school operation. (Project 64. Leader: W. F. Kumlien, Rural Sociology Department.)

Belle Fourche Irrigation Project, See page 36

Home Economics

Serviceability of Fabrics Containing New and Reused Wool

In an effort to determine some of the effects of blending reused wool with new wool, flannels of various combinations were made into skirts and worn for three periods of 1000 hours each. The third wear period has been completed and the garments cut into samples and subjected to laboratory measurements. These skirts were dry cleaned 15 times in the course of three periods of wear. Swatches of the same materials were dry cleaned an equal number of times and likewise tested in the laboratory to serve as a basis for comparison in determining

the effect of dry cleaning without wear. Another set of swatches was stored and has been sampled and measured along with the worn and dry cleaned fabrics.

Since cloth essentially is composed of fibers, measurements of the fibers themselves are now being made. When all of the data is complete it should be possible to make comparisons between new and reused wool fiber, and also show the changes in fabrics which occur as a result of wear, dry cleaning and storage. (Project 140. Leaders: Lillian O. Lund, Home Economics Department, in cooperation with Ethel L. Phelps, Minnesota Agricultural Experiment station.)

Measuring the Heat Transfer of Wool Materials

In temperate and cold climates, especially during the winter, wool clothing serves to protect the individual against losses of heat from the body to the surrounding air. The rate at which heat passes through the fabric is a major factor in evaluating such clothing from the standpoint of efficiency, comfort and satisfaction to the wearer.

Considerable work has been carried on by the South Dakota and Minnesota stations using wool flannels and all wool serge in serviceability studies. Plans are being set up to use samples of these same fabrics to measure the heat transfer of wool materials. Fabrics which are new and those which have been subjected to the conditions encountered during wear will be used to determine changes in heat transfer which may result from wear and also from dry cleaning. (Project 196. Leaders: Lillian O. Lund, Home Economics Department, in cooperation with Ethel L. Phelps, Minnesota Agricultural Experiment Station.)

Food Habits of Women Over 30 Surveyed

Field work for a Food Habit and Health History survey of women over 30 years of age in South Dakota was completed in early November 1949. A total of 322 women, ranging in age from 30 to 92 years, were interviewed. Of these, 168 were farm women; 84 lived in towns of less than 2,500 population; and 70 were women living in cities of over 2,500 population.

A record of the food eaten during the 24 hours preceding the interview was secured from each woman along with her answers to questions concerning her household, her activities and her health. The nutritive values of these 1-day diet recalls have been calculated and are being studied in relation to the health of the women. The data is still being tabu-

lated, but a few observations stand out: (1) that many of the women, especially those in the 5th, 6th, and 7th decades of life, are more than 15 percent overweight, (2) about 11 percent of the women were judged to be in poor health, 44 percent in fair health and another 44 percent in good health.

During the past year, 31 Brookings' women, ranging in age from 30 to 84 years of age, have cooperated in the study, which began in 1948, of the nutritional status and dietary needs of women in South Dakota. This makes a total of 60 Brookings' women who have been studied since the beginning of the project. Each of these women weighed and recorded the amount of each food eaten during one week, and came to the nutrition laboratory at the college for a series of nutritional status measurements.

The nutritive value of the diets has been calculated and is being studied in relation to the health and nutritional status of the women. A comparison with the recommended allowances of the National Research Council showed that there were many deficiencies. For example, only a few of the women were getting the recommended amount of calcium and only about half of the group were getting the recommended amount of ascorbic acid. In the case of ascorbic acid, the blood levels were correspondingly low.

All of the women were judged to be in good or fair health.

Work on this phase of the project will continue during the coming year to secure observations on more women in the 8th and 9th decades and to restudy some of the women studied in 1948-49. (Project 178. Leaders: Lida Burrill and Beth Alsup, Home Economics Department; Alvin Moxon, Chemistry Department; in cooperation with other stations in the North Central Region and the Bureau of Human Nutrition and Home Economics.)

Frozen Fruits and Vegetables, See page 32

Publications

Bulletins

- Norghum Sorghum. Bulletin 397. By C. J. Franzke.
Keeping Your Farm in the Family. Bulletin 398. By Max Myers.
Rations for Wintering Breeding Ewes. Bulletin 399. By R. M. Jordan.
Steel Fence Posts—Galvanized or Painted. Bulletin 400. By Dennis L. Moe.
James Hullless Oats. Bulletin 401. By J. E. Grafius and V. A. Dirks.
Electric Light and Power Systems for the Farm. Bulletin 402. By H. H. DeLong.
Feeding Dakota Lambs. Bulletin 403. By R. M. Jordan and Harry E. Weakly.
Community School Districts in the Making. Bulletin 404. By W. F. Kumlien.

Circulars

- Graphic Views of Changes in S. Dak. Agriculture. Circular 78. By Gabriel Lundy.
Corn Performance Tests—1949. Circular 79. By D. B. Shank.
Head Lettuce Varieties and Cultural Practices. Circular 80. By S. A. McCrory.
Grasses and Legumes for S. Dak. Circular 81. By M. W. Adams, J. G. Ross, W. W. Worzella and A. N. Hume.
Sheep Production in S. Dak. Circular 82. By R. M. Jordan.

Journal Articles by Staff Members

Agronomy

- J-228 D. W. Lambert, W. W. Worzella, R. C. Kinch, and J. N. Cheadle. Devitalization of Cereal and Weed Seeds of High Frequency. *Journal of American Society of Agronomy*, 1949.
J-229 D. L. Thompson, J. E. Grafius. Cytological Observations of the F₁ and Two Back-cross Generations of Triticum Vulgare x Agropyron Trichophorum. *Journal of American Society of Agronomy*, 1949.
J-231 J. E. Grafius, E. R. Hehn. Factors Associated with Grasshopper Resistance in Four Spring Wheat Crosses. *Journal of American Society of Agronomy*, 1949.
J-238 L. M. Stahler, E. I. Whitehead. The Effect of 2,4-D on Potassium Nitrate Levels in Leaves of Sugar Beets. *Journal of American Society of Agronomy*, 1950.
J-240 L. M. Stahler, D. E. Kratochvil, J. R. Hay. Safer Esters of 2,4-D and 2,4,5-T. *Crops and Soils*, 1950.

Animal Husbandry

- J-232 R. M. Jordan, W. E. Dinusson. Effect of Stilbestrol on the Growth Rate of Suckling Lambs. *Journal of Animal Science*, 1950.
- J-233 L. E. Johnson, G. S. Harshfield, Wm. C. McCone, "Dwarfism," A Hereditary Defect in Hereford Cattle. *Journal of Heredity*, 1950.
- J-235 R. M. Jordan. Effect of Stilbestrol on Fattening Lambs. *Journal of Animal Science*, 1950.
- J-237 C. I. Iverson, L. E. Johnson, T. Wright. The Effect of Age of Gilt on Size of Her First Litter. *Journal of Animal Science*, 1950.
- J-244 R. M. Jordan. The Feeding Value of Norghum Sorghum when Fed to Lambs. *Journal of Animal Science*, 1950.

Chemistry

- J-230 H. L. Klug, V. R. Potter, A. L. Moxon, D. F. Petersen. The *In Vivo* Inhibition of Succinic Dehydrogenase by Selenium and its Release by Arsenic. *Archives of Biochemistry*, 1950.
- J-234 H. L. Klug, A. L. Moxon, G. P. Lampson. Glutathione and Ascorbic Acid Values in Selenium Poisoning. *S. Dak. Academy of Science*, 1950.
- J-236 H. L. Klug, A. L. Moxon, D. F. Petersen. The Effect of Selenium, Cystine, and Low Protein Diets on Tissue Glutathione and Ascorbic Acid Levels. *S. Dak. Academy of Science*, 1950.
- J-239 H. L. Klug, G. P. Lampson, A. L. Moxon. The Distribution of Selenium and Arsenic in the Body Tissues of Rats Fed Selenium, Arsenic, and Selenium Plus Arsenic. *S. Dak. Academy of Science*, 1950.
- J-241 R. D. Harshfield, H. L. Klug. The Effect of Selenium on Anaerobic Glycolysis of Rat Liver Homogenate. *S. Dak. Academy of Science*, 1950.
- J-242 D. F. Petersen, Robert M. Pengra. The Effect of A.P.F. Supplementation of Some Protein Feeds on Selenium Toxicity in the Rat. *S. Dak. Academy of Science*, 1950.
- J-243 D. F. Petersen, H. L. Klug, R. D. Harshfield, A. L. Moxon. The Effect of Arsenic on Selenium Metabolism in Rats. *S. Dak. Academy of Science*, 1950.

Experiment Station Staff

Regents of Education

HONORABLE E. M. MUMFORD _____ Howard
HONORABLE MRS. H. T. DORY _____ Watertown
HONORABLE FRANK CUNDILL _____ Isabel
HONORABLE E. Y. BERRY _____ McLaughlin
HONORABLE ERIC HEIDEPRIEM _____ Custer

Executive

HONORABLE MRS. H. T. DORY _____
Regent Member
HONORABLE FRANK CUNDILL _____
Regent Member
FRED H. LEINBACH, PH.D. _____ President
A. M. EBERLE, M.S. _____ Dean of Agriculture
I. B. JOHNSON, M.A.G.R. _____ Director
R. A. LARSON _____ Treasurer
ELVA O. FEUERHELM _____ Secretary

Agricultural Economics

GABRIEL LUNDY, M.S. _____ Agr. Economist
MAX MYERS, PH.D. _____ Associate
OTTAR NERVIK, M.A. _____ Assistant
ERNEST FEDER, PH.D. _____ Assistant
RUSSELL L. BERRY, M.S. _____ Assistant
RUSSELL O. OLSON, M.S. _____ Assistant
MAURICE McLINN _____ Assistant

Agricultural Engineering

H. H. DELONG, M.S. _____ Agr. Engineer
JOHN L. WIERSMA, M.S. _____ Assistant
N. B. ANDERSON, B.S. _____ Assistant
DENNIS L. MOE, M.S. _____ Assistant
LEONARD J. ERIC, B.S. Agr. Engineer (SCS)

Agromony

W. W. WORZELLA, PH.D. _____ Agronomist
A. N. HUME, PH.D. _____ Associate
LEO F. PUHR, PH.D. _____ Associate
J. E. GRAFIUS, PH.D. _____ Associate
D. B. SHANK, PH.D. _____ Associate
C. J. FRANZKE, B.S. _____ Assistant
M. W. ADAMS, PH.D. _____ Assistant
L. O. FINE, PH.D. _____ Associate (Coop. USDA)
P. L. CARSON, M.S. _____ Assistant
V. A. DIRKS, M.S. _____ Assistant
J. G. ROSS, PH.D. _____ Assistant
F. C. WESTIN, M.S. _____ Assistant
BURTON L. BRAGE, PH.D. _____ Assistant
A. J. KLINGELHOF, M.S. _____ Assistant
GERHARD B. LEE, M.S. _____ Assistant
C. W. MOLDENHAUER, B.S. _____ Assistant
D. E. KETTERING, B.S. _____ Assistant
LYLE A. DERSCHIED, B.S. _____ Assistant
DONALD KRATOCHVIL, B.S. _____ Assistant
GLENN AVERY, B.S. Soil Survey Supervisor (SCS)
RALPH CLINE, B.S. Project Supervisor (SCS)
L. M. STAHLER, PH.D. _____ Associate (USDA)
E. J. WILLIAMSON, B.S. Lab. Soils Technician (BR)

Animal Husbandry

LESLIE E. JOHNSON, PH.D. _____
Animal Husbandman
KARL RASMUSSEN, PH.D. _____
Animal Husbandman
J. W. WILSON, M.S., LL.D. _____
An. Husb., Emeritus
TURNER WRIGHT, B.S. _____ Associate
R. M. JORDAN, M.S. _____ Assistant
J. WALTERS MCCARTY, M.S. _____ Assistant
GEORGE E. STAPLES, M.S. _____ Assistant
ELLIS A. PIERCE, M.S. _____ Assistant
RICHARD O. SMITH, M.S. _____ Assistant
WM. C. MCCONE, M.S. _____ Assistant
R. F. WILSON, PH.D. _____ Assistant
WM. E. DINUSSON, PH.D. _____ Nutritionist

Chemistry

A. L. MOXON, PH.D. _____ Chemist
H. L. KLUG, PH.D. _____ Associate Biochemist
E. I. WHITEHEAD, M.S. _____ Assoc. Biochemist
GEORGE GASTLER, M.S. _____ Assistant
A. W. HALVERSON, PH.D. _____ Assoc. Biochemist
FRANCES L. MOYER, M.S. _____ Asst. Biochemist
DONALD F. PETERSEN, M.S. _____ Res. Associate
ROBERT WILCOX, B.S. _____ Asst. Biochemist

Dairy

PHILIP L. KELLY, PH.D. Dairy Husbandman
GEO. E. TURNER, PH.D. _____ Associate
D. F. BREAZEALE, PH.D. _____ Associate
ARTHUR E. DRACY, PH.D. _____ Assistant
E. H. BARTLE, M.S. _____ Assistant
ROSCOE J. BAKER, PH.D. _____ Assistant

Entomology

H. C. SEVERIN, M.A. _____ Entomologist
GERALD B. SPAWN, PH.D. _____ Associate
WM. M. ROGOFF, PH.D. _____ Associate
JOHN A. LOFGREN, M.S. _____ Assistant
WAYNE L. BERNDT, B.S. _____ Assistant

Home Economics

ALICE ROSENBERGER, M.S. Home Economist
LIDA BURRILL, PH.D. _____ Associate
LILLIAN LUND, M.S. _____ Assistant
ELSE BETH ALSUP, M.S. _____ Assistant

Horticulture

S. A. MCCRODY, M.A. _____ Horticulturist
N. E. HANSEN, ScD. Horticulturist, Emeritus
MARCUS A. MAXON, M.S. _____ Assistant
SOLOMON COOK, PH.D. _____ Assistant

Plant Pathology

C. M. NAGEL, PH.D. _____ Plant Pathologist
L. T. RICHARDSON, PH.D. _____ Associate
JOHN T. SLYKHUIS, PH.D. _____ Assistant
GEORGE BRULHIL, PH.D. _____ Associate (BPI)

Poultry

WM. KOHLMAYER, M.S. _____
Poultry Husbandman
D. G. JONES, PH.D. _____ Associate
C. W. CARLSON, PH.D. _____ Assistant

Publications

MRS. MARJORIE R. KING _____ Station Editor
Rural Sociology
W. F. KUMLIEN, Ph.D. _____ Rural Sociologist

Veterinary

G. S. HARSHFIELD, D.V.M., M.S. _____
_____ Veterinarian
J. B. TAYLOR, D.V.M. _____ Assistant
MRS. J. W. McCARTY, B.S. _____
_____ Veterinary Technician

Substations

CARL B. LARSEN _____ Superintendent
Range Field Station, Cottonwood
ALBERT DITTMAN _____ Superintendent
North-Central Substation, Eureka
WADE R. PRINGLE _____ Superintendent
Central Substation, Highmore
HARRY E. WEAKLY _____ Superintendent
U. S. Newell Field Station, Newell
MIKE HOUSE _____ Superintendent
Antelope Range, Buffalo

RESIGNATIONS

	Date
Agricultural Economics	
RUSSELL O. OLSON, Assistant Economist _____	Oct. 24, 1949
Agricultural Engineering	
NIELS P. ANDERSON, Assistant Agricultural Engineer _____	Mar. 13, 1950
Animal Husbandry	
WM. E. DINUSSON, Nutritionist _____	Aug. 1, 1949
LESLIE E. JOHNSON, Head of Department _____	Sept. 1, 1949
Dairy	
P. L. KELLEY, Head of Department _____	Sept. 1, 1949
GEO. E. TURNER, Assistant Dairyman _____	Sept. 11, 1949
Station Chemistry	
ROBERT WILCOX, Biochemist _____	Sept. 10, 1949
Veterinary	
MRS. J. W. McCARTY, Lab. Technician _____	Apr. 18, 1950
Substation	
GERALD KEEHN, Superintendent, Highmore _____	Oct. 1, 1949

APPOINTMENTS

	Date
Agricultural Economics	
RUSSELL L. BERRY, Assistant Economist _____	Aug. 15, 1949
MAX MYERS, Associate Economist _____	Sept. 26, 1949
ERNEST FEDER, Assistant Economist _____	Sept. 20, 1949
Agricultural Engineering	
DENNIS L. MOE, Assistant Agricultural Engineer _____	Oct. 1, 1949
Agronomy	
GERHARD B. LEE, Soil Surveyor _____	July 1, 1949
AMBROSE J. KLINGELHOETS, Soil Surveyor _____	July 1, 1949
CALVIN W. MOLDENHAUER, Assistant Agronomist _____	July 1, 1949
DWAYNE I. KETTERING, Assistant Agronomist _____	July 1, 1949
BURTON L. BRACE, Assistant Agronomist _____	June 1, 1950
Animal Husbandry	
KARL RASMUSSEN, Head of Department _____	Oct. 12, 1949
RICHARD F. WILSON, Assistant Animal Husbandman _____	Sept. 16, 1949
Dairy	
ROSCOE J. BAKER, Assistant Dairyman _____	Jan. 1, 1950
Home Economics	
ELSIE BETH ALSUP, Assistant Nutritionist _____	Sept. 15, 1949
Horticulture	
SOLOMON COOK, Assistant Horticulturist _____	Apr. 25, 1950
Poultry	
C. W. CARLSON, Assistant Poultry Husbandman _____	Oct. 15, 1949
Station Chemistry	
ANDREW W. HALVERSON, Associate Biochemist _____	Sept. 15, 1949
Substation	
WADE R. PRINGLE, Superintendent, Highmore _____	Mar. 20, 1950

Financial Report—Agricultural Research Funds—July 1, 1949 to June 30, 1950

	FEDERAL RESEARCH FUNDS				STATE RESEARCH FUNDS	
	Hatch	Adams	Purnell	Bankhead Jones	Research and Marketing	Experiment Station
Appropriation	\$15,000.00	\$15,000.00	\$60,000.00	\$27,733.01	\$58,817.76	\$181,161.00
Balance on Hand, 7/1/1949					8,704.48	
Sale Proceeds						\$ 27,926.10
Rentals						93,869.92
						5,474.97
TOTAL	\$15,000.00	\$15,000.00	\$60,000.00	\$27,733.01	\$67,522.24	\$181,161.00
						\$127,270.99

EXPENDITURES

Personal Services	\$ 6,543.16	\$13,628.17	\$42,738.15	\$18,398.14	\$31,638.56	\$151,791.00	\$ 13,708.06
Travel	650.75	328.55	2,683.62	729.77	4,157.14	1,630.74	2,988.05
Transportation	67.92	52.35	120.01	116.11	20.26	321.98	193.05
Communication Service	13.80	3.76	171.93	31.90	15.00	600.71	464.20
Rents and Utility Services	6.00		186.52	.75		513.02	752.58
Printing and Binding	2,912.83		3,905.12	481.10	839.06	2,606.67	1,987.16
Other Contractual Services	269.11	74.02	800.91	373.63	253.00	993.83	1,777.03
Supplies and Materials	3,006.24	913.15	6,836.13	5,323.70	5,961.62	14,747.99	61,160.50
Equipment	1,530.19		2,557.61	2,277.91	8,662.60	7,955.06	13,662.34
TOTAL	\$15,000.00	\$15,000.00	\$60,000.00	\$27,733.01	\$51,547.24	\$181,161.00	\$ 96,692.97
Unexpended balance, 6/30/1950					15,975.00		30,578.02
GRAND TOTAL	\$15,000.00	\$15,000.00	\$60,000.00	\$27,733.01	\$67,522.24	\$181,161.00	\$127,270.99